An Evaluation of Limousin and Simmental Bulls in Britain

Final Report of the Limousin and Simmental Tests Steering Committee

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Limousin and Simmental Tests Steering Committee

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Report of the evaluation of the first importation into Great Britain in 1970-71 of Limousin bulls from France and Simmental bulls from Germany and Switzerland

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Contents

Committee Members

Foreword

Summary 6

1 Introduction 9

2 The planning and organisation of the trials 14

3 Calving surveys and results 18

4 Production trials on farms 23

5 The production trial at experimental centres 33

6 Discussion 38

Appendix 1 The calving surveys 51

2 The comparison of Friesian, German Simmental cross Friesian, Swiss Simmental cross Friesian and Limousin cross Friesian cattle in intensive cereal beef production 63

3 The comparison of German Simmental, Swiss Simmental and Limousin crosses with pure Friesians in semi-intensive beef-production 68

4 The evaluation of Limousin and Simmental breeds as sires of suckled calves 75

5 The food conversion efficiency and carcase quality of steers by Friesian, Hereford, Limousin, German Simmental and Swiss Simmental bulls out of Friesian cows 78

6 Economic evaluations 95

References and further reading 99

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Foreword

On March 26, 1970 it was announced that the Minister of Agriculture, Fisheries and Food and the Secretary of State for Scotland had decided to allow the import of Limousin cattle from France, and Simmental cattle from West Germany and Switzerland.

A condition of the imports was that the breed societies should be responsible, in conjunction with the Agricultural Departments, the Meat and Livestock Commission and AI Organisations, for a testing programme to evaluate the merits of the breeds under British conditions.

The Limousin and Simmental Tests Steering Committee was set up in May 1970 to plan and co-ordinate the evaluations.

An evaluation of cattle breeds is inevitably a long term undertaking. Reports of each phase of the evaluation have been issued from 1972 to 1975 through the MAFF Press Office, but the Committee considered that the results obtained should be permanently recorded in this composite report which also attempts to quantify, in economic terms, the advantages and disadvantages of the breeds. We have also recorded our views on the efficiency of the breed evaluations, most of which were carried out under practical farm conditions, and have commented on the way such studies might be carried out in the future.

The work could not have been completed without the co-operation of the major organisations concerned with cattle production in Great Britain. I also wish to acknowledge the support of members of the Steering Committee, the willing co-operation and valuable contributions of members of the Working Party and in particular the indefatigable efforts of Mr F K Deeble of MAFF who acted as Secretary to the Committee and co-ordinator of the trials.

W. HOLMES
Chairman

6.7.76

Summary

1 The report presents the main results from the evaluation of Limousin bulls from France, and Simmental bulls from Germany and Switzerland which were imported to Great Britain in 1970/71 and available through artificial insemination. Since then breed populations may have changed as a result of further importations and selection.

2 The trials were co-ordinated by the Limousin and Simmental Tests Steering Committee and financed by the Artificial Insemination Organisations, the Meat and Livestock Commission, the Ministry of Agriculture, Fisheries and Food and the Scottish Agricultural Colleges.

3 Records of calving experience from dairy and beef cows were collected (Chapter 3 and Appendix 1). Bulls of the imported breeds produced more calf deaths and seriously difficult calvings from first calf dairy and beef type dams than did Hereford sires (Sections 3.4 and 3.12).

4 With Friesian cows there was no real difference in calf mortality from the use of the two types of Simmental though Swiss Simmentals gave higher mortality than the Limousin bulls which were themselves similar to Hereford sires. Limousin and Simmental bulls gave similar percentages of difficult calvings, all greater than Hereford sires (Sections 3.5 and 3.6).

5 The average gestations of dairy cows mated to the imported breeds were up to 7 days longer than those of cows mated to Friesian or Hereford bulls (Section 3.8).

6. Calves by Simmental bulls were heavier at birth than those by Limousin bulls out of similar types and ages of dams (Section 3.9).

7 Simmental bulls did not colour mark their progeny as consistently as Hereford bulls. They produced a wider range of colours and fewer white heads. The Limousin breed did not distinctly colour mark its progeny from the breeds of cow used (Section 3.10).

8 The progeny of imported bulls out of Friesian or Ayrshire cows were compared with contemporary pure Friesian and Friesian cross cattle on commercial farms recorded by MLC and at the Scottish Agricultural Colleges' farms. Progeny out of single suckler beef cows were also compared with contemporaries by British bulls.

9 Growth rates and carcase quality were assessed on commercial and institutionally owned farms under both intensive cereal and semi-intensive feeding regimes (Chapter 4 and Appendices 2, 3 and 4).

10 German Simmental crosses generally grew faster than contemporaries, but there were only small differences between Friesians and Limousin or Swiss Simmental crosses (Section 4.5).

11 Crosses from the imported breeds had higher killing out percentages than Friesians and Friesian crosses particularly the Limousin cross cattle on the intensive cereal beef trials (Section 4.6).

12 German Simmental crosses produced greater weights of carcase per day of age than did Friesians but the progeny of Limousin and Swiss Simmental bulls gave similar carcase gains to Friesians (Section 4.7).

13 The imported breed crosses produced carcases with markedly better conformation scores than Friesians or Friesian cross contemporaries (Section 4.8). Simmental crosses had lower external fat scores also whilst those of the Limousin cross progeny were even lower in the intensive feeding regime (Section 4.9). This result suggests the crosses could have been taken to heavier carcase weights without becoming too fat for present day requirements.

14 Calves from beef cows by Simmental bulls were lighter at birth, 200 days and 300 days of age than Charolais crosses, but they were heavier than Limousin crosses which were, in turn, heavier than Hereford crosses. This ranking was reflected in subsequent growth rates and slaughter weights (Sections 4.14 and 4.15).

15 Steers by Friesian, Hereford, Limousin, German Simmental and Swiss Simmental bulls, out of Friesian cows, were individually fed a complete pelleted diet at experimental centres. The animals were serially slaughtered at defined ages and their carcases dissected by the Meat and Livestock Commission (Chapter 5 and Appendix 5). This trial was designed to investigate feed conversion efficiency and carcase composition (Sections 5.1 and 5.4).

16 On the basis of the data from serial slaughter it was estimated that:

a) At 430 kg liveweight at slaughter, Hereford crosses would have more total fat than the Friesians or crossbred progeny by the newly imported breeds. Limousin crosses would have the highest carcase percentage, the highest percentage and greatest weight of lean and the lowest percentage of bone (Section 5.7).

b) If all animals were slaughtered at the same total fat percentage (20% excluding kidney knob and channel fat), Hereford crosses would have the lowest slaughter weight and the lowest killing out percentage. The killing out percentage of Limousin crosses would be substantially higher than that of the Hereford crosses and higher than those of the other breeds. Limousin crosses would yield the most lean meat and Hereford crosses the least (Sections 5.8 to 5.10). Hereford crosses would require the least feed per unit weight but they would be closely followed by Limousin crosses. Friesians would show the lowest efficiency of feed conversion to lean meat (Section 5.12).

17 In Chapter 6 an attempt is made to set out the components contributing to an assessment of the economic advantages and disadvantages of the newly imported breeds in comparison with the Hereford breed as crossing sires.

When the individual animals are considered the growth and carcase advantages of Simmental would seem to be sufficient to counterbalance the extra costs of the calving problems they produce, and the extra potential carcase value of Limousin crosses would provide an appreciable financial advantage over Hereford crosses.

When the financial margin per day of age is considered the Hereford crosses would equal the Limousin crosses and both would exceed the performance of Simmental cross or Friesian cattle.

When the area required to provide feed is considered the financial margin per hectare would favour the Hereford crosses.

18 The efficiency of the evaluations is discussed and the problems of co-ordinating trials and the collection of records on commercial farms are considered (Sections 6.22 to 6.26). Whilst the importance of ‘on-farm’ assessment is accepted, they were costly. It is considered that any future evaluations should be carried out primarily at evaluation centres and on a few closely monitored farms. The need for adequate manpower and finance to carry out the supervision is stressed.

19 Comparisons of breed demand through artificial insemination since the importations provide a further example of the farmers’ assessments of the breeds (Section 6.29). The demand for Simmental semen rose until 1974 and has since fallen. The demand for Limousin has remained at a lower but more constant level.

1 Introduction

1.1 In 1960 the Terrington Committee published recommendations that Charolais cattle should be introduced to the United Kingdom provided that they were subject to careful evaluation. Semen from 27 bulls became available for use, through AI only, from 1 March 1962. Tests were conducted under the aegis of the Ministry of Agriculture, Fisheries and Food (Smith 1963, 1964 and 1966, Smith and Boyd 1964 and Milk Marketing Board 1966) and as a result the breed was accepted into Britain.

Throughout the 1960s cattle breeders turned their interest to other European breeds of potential value. Many private surveys of breed potential were conducted and I L Mason published a full review of the European breeds in Animal Breeding Abstracts (1971).

1.2 Following considerable discussion the Ministry of Agriculture, Fisheries and Food and the Department of Agriculture for Scotland announced, on 26 March 1970, that there would be a controlled importation of Limousin cattle from France and of Simmental cattle from Switzerland and from Germany. This importation was agreed on the condition that the new Breed Societies collaborated with the Agricultural Departments, AI Organisations and the Meat and Livestock Commission in the conduct of evaluation of the breeds under British conditions.

1.3 A Limousin and Simmental Tests Steering Committee was set up in May 1970 to co-ordinate the trials. Although shortly after the Committee's appointment there was a relaxation of the policy on the importation of farm livestock, the Steering Committee decided to proceed with the evaluation so that a body of factual evidence on the Limousin and Simmental breeds could be assembled and in the belief that the experience gained would be of more general value in the evaluation of breeds and for the advancement of cattle production. The Committee's plans for the testing programme were announced on 30 December 1970.

1.4 This report gives a comprehensive account of all the work which has been conducted. Some aspects of the work deserve more detailed consideration and will be described in the appropriate scientific publications.

1.5 In Britain beef bulls sire about two thirds of the calves used for beef production. These calves may be from beef suckler cows or from dairy cows and account for 25% and 20% of home beef production respectively. The remaining beef production is from pure dairy calves (21%), cull dairy and beef cows (13% and 9%) and Irish stores (12%) (Craven and Kilkenny 1976). The Friesian is the predominant dairy breed involved although the Ayrshire is of considerable significance in Scotland. It was considered the evaluation of Limousin and Simmental cattle should reflect the normal pattern of beef calf production as well as the different feeding regimes practised.

1.6 A problem with any evaluation of an importation is to ensure that it involves a representative sample of the breed which exists in its area of origin or at least is representative of the particular sample of cattle introduced to the importing country. It is particularly important to assess the contribution of those animals which are likely to have the greatest influence on the breed in its new home. For this and for other practical reasons the Committee decided that the cattle to be tested would be those bulls standing at Artificial Insemination Centres and which were almost certain to make the major contribution from the breed in its earliest years.

1.7 German Simmental bulls became available for use in the AI service in October 1970; the Swiss Simmental in January 1971 and Limousin bulls in June 1971. Calves for the evaluation were collected from inseminations carried out in Great Britain from 3 October 1970 to 25 April 1972. Calf collections were, however, made at defined times and from defined areas to meet the requirements of the testing plans and those of the co-operating farmers. The approximate numbers of commercial (rather than pedigree) inseminations in the periods from which, subsequently, calves were collected are given in Table 1.1.

Table 1.1 *Number of first inseminations by breed*

German Simmental	Swiss Simmental	Limousin
20,000	10,000	4,000

For various, reasons including suitability for artificial insemination procedures and variations in regional demand, the contribution per bull varied widely. Moreover as results of the evaluations became available there was a change in the pattern of demand for particular bulls.

There have subsequently been further importations of bulls which have been used at Artificial Insemination Centres and the breed population has undoubtedly changed but the data presented in this report give guidance on the performance of the first importations. We believe that our initial studies have encouraged the routine assessments of calving performance of all new bulls and the development of the evaluations of the performance of their progeny which are now conducted by the Artificial Insemination Organisations and the Meat and Livestock Commission.

1.8 A matter of concern to us in planning the evaluations was that we should take account of all the effects which the introduction of new breeds might have on cattle production systems. Both practical experience and the recent emphasis on systems analysis in agriculture have emphasised the importance of the inter-relations of various components on the overall productivity and profitability of agricultural enterprises. The evaluations which are described had perforce to be conducted on various separate aspects of cattle production systems but in our planning and in our eventual evaluations we considered that we must assess the potential overall effect of the imported breeds. For this we considered two major aspects:

Breeding
Feeding

1.9 In evaluating the Breeding Merit of bulls of a new beef breed used for crossing on beef and dairy cows and heifers it is important to assess and, where possible, express quantitatively the following effects which are all of practical and economic importance:

Conception rate
Gestation length
Incidence of stillbirths and neonatal mortality of calves
Incidence of cow deaths
Calf birth weights
Incidence of dystokia
Effect of difficult calvings on subsequent production of the cow
Colour marking of calves.

These can then be compared with the results obtainable with purebreeding dairy cows and heifers and crossbreeding dairy and suckler cows and heifers with the breeds of bull already in common use. The factors can be expressed as the number of live births per 100 cows per year
less allowances for:

Incidence of cow deaths
Incidence of dystokia
Effect of difficult calvings on subsequent production of the cow

plus a possible bonus for:

Colour marking of calves.

The breeder, whether of dairy or of beef cattle, measures success as output or sale of calves per 100 cows put to the bull or per 100 hectares after allowance has been made for the variable costs and possible adverse effects.

1.10 To assess the Feeding Merit of new crosses for beef production it is desirable to measure:

Ease of calf rearing
Growth rate to finished condition
Feed utilisation
Carcase composition
Carcase quality
Adaptation to particular husbandry environments.

Productivity depends on the proportion of calves successfully reared, their feed utilisation per unit saleable weight, and their carcase quality. The feeder measures success by the output of saleable product per calf purchased and in financial terms by gross margin per animal and per hectare in a given time. The feeder would not, however, be directly concerned with performance of the breeding enterprise.

1.11 When breeding and feeding were conducted on the same farm the farmer would be much concerned with both aspects and would wish to offset any disadvantages associated with breeding with any advantages from feeding. That these two aspects of beef production are both economically important is well established. Calculations made by the Meat and Livestock Commission, from records collected in 1975, showed an increase of about £1.00 gross margin per cow for each extra calf weaned per 100 cows put to the bull. Data for rearing suckled calves showed an increase in gross margin per cow of about £6.00 for an increase in daily gain of 0.1 kg. The corresponding figure for finishing cattle was about £12.00 per beast.

1.12 The Steering Committee met for the first time in July 1970, appointed a Working Party to carry out the detailed planning and consideration of the evaluations and approved the general scheme in December 1970. The inseminations were conducted in 1970–72 and the data have been accumulated from 1972–75. Reports were prepared and issued as soon as possible after the completion of each study.

Report number	*Title*	*Date of issue*
1	Interim report on the calving surveys.	13 November 1972
2	Final report on the calving surveys.	1 November 1973
3	The comparison of Friesian and German Simmental cross Friesian cattle in intensive cereal beef production.	20 May 1974
4	The comparison of German Simmental cross Friesian and Friesian cattle in semi-intensive beef units in Scotland.	27 August 1974
5	The comparison of German Simmental cross Ayrshire and Friesian cross Ayrshire cattle in semi-intensive beef units in Scotland.	27 August 1974
6	The feed conversion efficiency and carcase quality of steers by Friesian, Hereford, Limousin, German Simmental and Swiss Simmental bulls out of Friesian cows.	9 September 1974
7	The evaluation of the Limousin and Simmental breeds as sires of suckled calves.	11 November 1974
8	The comparison of Friesian, Swiss Simmental cross Friesian and Limousin cross Friesian cattle in intensive cereal beef production.	19 May 1975
9	The comparison of Simmental cross Friesian, Limousin cross Friesian and Friesian cattle in semi-intensive beef units in England.	1 December 1975

The surveys and trials are described in the following chapters and supporting details, based on the reports issued for each set of trials, appear in the Appendices.

2 The planning and organisation of the trials

2.1 After preliminary discussion the Committee agreed that the breed evaluations should include the following:

i A survey of calving performance when the breeds were used on dairy cows, particularly Friesians and Ayrshires.

ii Assessment of the growth, feed efficiency and carcase quality of their progeny out of dairy cows both under all-concentrate and grass feeding regimes.

iii Assessment of the growth of their progeny out of single suckler cows.

iv Evaluation of the merit of the breeds as sires of single suckler cows. This is a long term study and results are not yet available.

The Committee also expected that some crossbred female progeny by Simmental sires would be milked alongside native breeds and that the milk records would become available through the official recording schemes in England, Wales and Scotland.

No breed testing centres were then available and the Committee accepted that most of the work would have to be carried out on commercial farms. It was also agreed that most of the crosses to be used would be from the Friesian which is predominant in the national dairy herd. Furthermore, it was soon obvious that the work would require financial incentives but the Committee itself had no funds. One of its major successes was in arranging and coordinating the series of trials with the assistance and financial support of the Associated Artificial Insemination Centres, the Meat and Livestock Commission, the Milk Marketing Board, the Ministry of Agriculture, Fisheries and Food, the Scottish Agricultural Colleges and the Scottish Milk Marketing Board.

2.2 Often in the past breed evaluations had been conducted with insufficient numbers of animals. Estimates were made, therefore, of the appropriate numbers of animals which should be included in the different trials. It was assumed that the variation in the progeny of the imported breeds would be similar to that in native breed crosses. Furthermore, as much of the work was to be carried out on commercial farms the coefficients of variation for growth rate found by the Meat and Livestock Commission in their 'on farm' commercial beef recording scheme of 10–15% were used. There was little evidence on the numbers required to identify differences for other traits.

2.3 Minimum numbers of animals to have a 50% or an 80% chance of detecting three levels of average growth rate performance were calculated. The levels chosen were:

i a 5% change in performance in both intensive and semi-intensive beef systems.
ii 0.05 kg per day in intensive systems.
iii 0.05 kg per day in semi-intensive systems.

MLC surveys had shown that differences in average daily gain of 0.05 kg per day were of economic significance. The numbers required were calculated at two levels of probability ($p \geqslant 0.05$ and 0.01) and at two levels of variation within each group ie coefficients of variation of 10% and 15%.

The formula used was: $\mathbf{n} = \mathbf{t}_{na}{}^2 \cdot \frac{2s^2}{\mathbf{d}^2}$

where $\mathbf{n}$ = number of individuals in each group being compared
$\mathbf{d}$ = difference between 2 group means
(t_{na} = value of t at two levels of probability ($a = 0.05$ and 0.01) for each level of n
s = standard deviation of individuals within the groups being compared.

The results of the calculations are given in the tables below.

Table 2.1a *Estimated number of animals required (50% probabilities of obtaining significance)*

	5% change		0.05 kg/day semi-intensive		0.05 kg/day intensive	
P	0.05	0.01	0.05	0.01	0.05	0.01
10%	33	57	21	38	38	67
15%	71	122	46	78	84	141

Table 2.1b *Estimated number of animals required (80% probabilities of obtaining significance)*

	5% change		0.05 kg/day semi-intensive		0.05 kg/day intensive	
P	0.05	0.01	0.05	0.01	0.05	0.01
10%	65	96	42	63	77	115
15%	141	210	91	136	170	255

After considering the figures in Table 2.1a and 2.1b and since it was probable that variation on farms would be high, it was decided to aim to include sufficient animals to give a 50% chance of detecting differences in growth rate significant at the 1% level or to give an 80% chance of detection at the 5% level of probability. A further objective was to include approximately equal numbers of progeny by each bull.

2.4 However, at this stage in planning, the Committee had no indication as to the extent to which the breeds would be used by farmers. It was aware that the experiences of the Milk Marketing Board (MMB) and the Meat and Livestock Commission (MLC), from their work on progeny testing Herefords were that some 10 inseminations of this breed had to be carried out over a limited period in order for them to be able to buy one male calf. Thus to allow for possible difficulties in procuring exotic breed crosses, calf rejections and births outside the collection period for the trials, it seemed that some 5,000 inseminations would have to be carried out from each breed. In the event the number of Limousin inseminations were below the target figure and hence there were fewer Limousin crosses in the trial than planned.

2.5 To procure the calves staff of the Meat and Livestock Commission, (jointly with the Scottish Agricultural Colleges in Scotland) examined Artificial Insemination Centre records for farmers with cows inseminated by the imported breeds in the required periods. Visits were then made to the farmers to negotiate the purchases of male calves. Since female calves were eligible for Breed Society Grading Up Schemes they were too expensive for experimental work. The location and purchase of calves and their delivery to MLC recorded farms and experimental centres was very costly in staff time and mileage.

2.6 In the event the AI Organisations decided to progeny test their bulls within the breed evaluation programmes. They agreed to pay the extra costs for the additional calves to obtain a progeny test of the desired accuracy; this same facility was offered to private owners of bulls but none took up the option. As a result of this expansion of the scope of the investigations some trials included larger numbers of cattle than were needed for the breed evaluations alone.

2.7 The progeny of bulls normally available through AI Organisations were used in the trials, since it was considered these would have the greatest immediate effect on commercial beef production. The number of bulls and their ownership are shown in Table 2.2.

Table 2.2 *Bulls owned by* AI *Organisations siring progeny included in the evaluations*

	German Simmental (GS)	Swiss Simmental (SS)	Limousin (L)
Associated AI Centres			
Avoncroft Cattle Breeders Ltd	—	3	—
Cambridge and District Cattle Breeders Ltd	1	—	—
Hampshire Cattle Breeders Society Ltd	1	1	—
Scottish Milk Marketing Board	6	—	—
Cattle Breeders Improvement Services Ltd	—	3	—
Milk Marketing Board of England and Wales	5	6	6
Total	13	13	6

3 Calving surveys and results

Economic significance of calving difficulties and calf mortality

3.1 On the basis of the available statistical evidence the aim in the calving surveys was to assemble data on 200 calvings by each bull but it was not always possible to attain this target. In England and Wales, farmers who had used the imported sires were sent a prepaid postcard on which was entered the name and/or number of the dam, the number of the sire and the date of insemination. They were asked to answer several questions when the cows had calved and to return the cards to the AI Organisation; the figures below relate to records received over the period to mid 1973. Farmers were asked whether the calf was born dead or died within 48 hours after birth and to indicate whether the calving was normal, required some assistance or was difficult. In addition they were asked to say whether or not veterinary assistance was given. In Scotland, the Scottish Milk Marketing Board staff interviewed and completed cards for the farmers who took inseminations between specified dates. A second card was completed for those calvings indicated as 'difficult'.

3.2 The Committee accepted that the assessment of calving difficulty and the description of head colour and coat pattern would be subjective but no more so for the imported breeds than for other similar surveys on established breeds. It was not possible to ensure strict contemporary comparisons of calving difficulty and calf mortality with other breeds of sire but comparisons could be made with analogous surveys of the use of other breeds of bull on the same breeds of cow. This has been done in the tables below.

3.3 The figures relating to Charolais and Hereford sires in the following tables came from surveys carried out by the Milk Marketing Board at the same time and in the same way as for the imported breeds. Though all the breeds were not necessarily used on the same farms it is considered that they provide valid comparisons.

3.4 As would be expected the incidence of mortality and serious difficulty was much greater in heifers than in cows; the use of the imported breeds resulted in higher incidences of both traits than did the Hereford. The results, given in Table 3.1 below, provided ample confirmation of the warning given at the outset by the Committee and the AI Organisations that bulls of large breeds should not be used on heifers. For comparison, MMB information from 1,595 calvings from Friesian heifers mated to Friesian bulls gave the incidence of serious difficulty as 5.7% .These data were summarised from answers given by farmers to inseminators when they visited the farms.

Table 3.1 *Calvings from Friesian heifers*

Sire breed	No of sires	No of calvings	% mortality	% serious difficulty (incl. veterinary assistance)
German Simmental	13	218	6.4	5.5
Swiss Simmental	10	144	19.4	13.9
All Simmental	23	362	11.6	8.8
Limousin	6	388	10.3	8.2
Hereford (Team V)	27	933	5.0	2.5

3.5 Table 3.2 gives the calving results from Friesian cows; differences of less than 1.5% are not significant.

Table 3.2 *Calvings from Friesian cows*

Sire breed	No of sires	No of calvings	% mortality	% serious difficulty (incl. veterinary assistance)
German Simmental	13	3,187	4.0	3.3
Swiss Simmental	10	2,138	4.8	3.7
All Simmental	23	5,325	4.4	3.5
Limousin	6	971	3.3	2.4
Charolais (E Series)	11	1,053	5.5	5.4
Hereford (Team V)	27	4,726	2.7	0.9

There was no real difference in calf mortality between the Simmentals though the Swiss Simmental produced significantly higher mortality than the Limousin which was similar to the Hereford. The Hereford produced fewer difficult calvings than either the Limousin or Simmental which were similar. The Charolais team produced somewhat higher mortality and calving difficulties than the Simmental or Limousin but an earlier Charolais team (Series C) yielded results similar to the Simmental. Data collected by the MMB, but by the different survey technique described, showed that the incidence of serious difficulty in 17,016 calvings from Friesian cows mated to

Friesian bulls was 2.5%. The data in Table 3.2 refer to averages for teams of bulls; there were significant differences between bulls within breeds and appropriate action was taken by the AI Organisations.

3.6 The data suggest that in calvings from Friesian cows the Limousin breed provides no greater risk of difficult calving than the Friesian sires but there is more calving difficulty when the Friesian is mated to a Simmental sire than in Friesian to Friesian mating.

3.7 There were insufficient calvings to Ayrshire heifers to provide a firm conclusion and there were no differences between the imported breeds in the percentage mortality they caused in calves out of Ayrshire cows. The overall figure was slightly higher than with Friesian cows but there is no ready explanation for this. Limousin gave fewer difficulties than the German Simmental but the results were similar to the Swiss Simmental. (The incidence of mortality and calving difficulty from mating of Ayrshire females to Ayrshire bulls is not available from the AI Organisations).

3.8 Gestation lengths were recorded in the surveys. In general, for both heifers and cows, there was little difference in average gestation length between the Charolais, German Simmental and Swiss Simmental crossed with the Friesian. For cows they were 2–3 days longer than the Hereford cross Friesian and 3–4 days longer than the average for a Friesian carrying a purebred calf (281 days). Calves by the Simmental bulls out of Ayrshire cows were carried 4 days longer than a purebred calf.

Calves by the Limousin bulls out of Friesians were carried some 5 and 6 days longer than those by the Hereford and Friesian respectively. Calves by Limousin out of Ayrshire cows were carried 6–7 days more than the purebred Ayrshire. It is important that farmers take the longer gestations into account when planning steaming-up and calving preparations.

3.9 The birthweights of the calves out of cows by the groups of Simmental bulls were similar at 44 kg average weight but the Limousin produced smaller calves, 42 kg average weight. The average weights of calves from Friesian heifers were 41 kg for Simmental and 38 kg for Limousin crosses.

Higher birthweights and longer gestation lengths were associated with increased difficulty at calving in the surveys but the data were insufficient for a precise measure of the relationship.

3.10 Some 86% of the Simmental progeny out of Friesian dams were recorded as 'broken colour', with some 52% of these described as red or brown and 25% black,

Some 92% were reported as having white heads, a category which included those with ‘spectacles’. About 81% of Limousin cross Friesian calves were described as ‘one colour’; about 34% of these were brown and 48% black.

It seems clear that the Simmental breeds do not ‘colour mark’ their progeny as consistently as does the Hereford breed; they also produce a wider range of colours and do not invariably give white heads. Colour inheritance in Limousin crosses is, in general, much as would be expected. A full report of the Calving Surveys is given in Appendix 1 page 51.

3.11 The Limousin and Simmental Tests Steering Committee was unable to collect data on the incidence of calving difficulties, calf mortality and calf birthweights when the newly imported breeds were used on beef cows in suckler herds. However, the Meat and Livestock Commission has supplied results from surveys it has carried out subsequent to those described above; the data have been taken from a report by Kilkenny and Stollard 1976. There is some danger in making direct comparison of dystokia levels from different surveys because of differences in the classification adopted. But the following tables provide support for the relative differences shown between the sire breeds in the dairy cow surveys.

Table 3.3 *Calving difficulties and calf mortality in beef herds (from Kilkenny & Stollard 1976)*

	Calvings from heifers				Calvings from cows			
Sire breed	No of records	% difficult calvings	% calvings requiring surgery	% mortality	No of records	% difficult calvings	% calvings requiring surgery	% mortality
Simmental	304	14.0	3.9	6.3	1,674	8.9	1.2	4.4
Limousin	298	10.3	2.6	5.1	798	7.4	0.7	3.8
Charolais	508	15.3	4.6	7.4	505	9.0	1.2	4.6
Hereford	2,266	6.5	0.6	2.9	5,368	4.0	0.3	2.0

3.12 The authors state:

3.12.1 that heifers had significantly higher levels of calving difficulties, calvings requiring surgery ($p < 0.01$) and calf mortalities ($p < 0.05$) than cows.

3.12.2 in the calvings from cows, Simmental, Limousin and Charolais produced significantly ($p < 0.01$) higher levels of difficult calvings, calvings requiring surgery and calf deaths than Hereford sires but there were no significant differences between the averages for the three imported breeds except that the Limousin produced fewer calvings requiring surgery.

3.12.3 in the calvings from heifers the number of records was relatively small but the imported breeds produced considerably higher incidences of calvings which were difficult or required surgery and greater mortality than the Hereford sires. (In the original analysis the authors 'pooled' breeds into four groups on the basis of their birthweights).

3.12.4 the survey showed that within sire breed groups birthweights were significantly higher ($p < 0.01$) for assisted calvings than for unassisted calvings and that the large breeds should be avoided for heifer matings.

3.13 The average birthweight for calves out of heifers and cows is given in the following table:

Table 3.4 *Birthweights in beef herds by breed of sire*

	Calves from heifers		Calves from cows	
Sire breed	No of records	Weight (kg)	No of records	Weight (kg)
Simmental	279	37.4	1,022	42.1
Limousin	226	34.4	464	39.5
Charolais	404	38.6	1,898	43.2
Hereford	2,004	30.4	6,439	34.3

On average the Simmental cross calves out of cows were some 3 kg heavier at birth than those by the Limousin sires, approximately the same as in the dairy cow surveys. The birthweights of calves born out of heifers averaged 9% less than birthweights out of cows; this difference was significant ($p < 0.01$).

4 Production trials on farms

The designs of the different farm production trials in intensive and semi-intensive beef units are briefly outlined below and the main results are summarised together in the following section. The results of trials in suckler herds and milk yield and quality records are also given. Detailed results are given in Appendices 2, 3 and 4.

Intensive cereal beef production in England

4.1 MLC staff purchased 241 Simmental cross Friesian and 48 Limousin cross Friesian steer calves and placed them with 293 Friesian steers on commercial beef units. The German Simmental cross Friesian cattle (GS×) and contemporary Friesians (F) were purchased in the winter of 1971/72 and were recorded on 12 farms. The Swiss Simmental cross Friesian (SS×) and Limousin cross Friesian (L×), together with their contemporary Friesians, were purchased in the winter of 1972/73 and were recorded on 11 farms.

The farms reared all the calves according to their normal system and they decided when the animals were ready for slaughter. The animals were weighed at approximately 100 days old and within a few days of slaughter.

Carcase weights were recorded and carcase appraisals made on 183 Simmental cross cattle, 40 Limousin crosses and 212 Friesian contemporaries. The left sides of 15 Friesians and 20 German Simmental cross Friesian carcases were evaluated in detail involving cutting into standardized wholesale joints followed by separation into lean, fat and bone. Unfortunately carcase dissections could not be arranged on the Swiss Simmental and Limousin cross animals and their contemporary Friesians. Full results of the trials are given in Appendix 2 page 63.

Semi-intensive beef production in Scotland

4.2 German Simmental bulls, owned by the Scottish Milk Marketing Board, were used to provide calves in two trials; one, on 6 commercial farms, compared 110 German Simmental cross Friesian (GS×) steers with 75

Friesian (F) steers whilst in the other, at the 3 Scottish Agricultural Colleges, there were 87 German Simmental cross Ayrshire (GS×A) and 76 Friesian cross Ayrshire (F×A) steer calves.

In both trials the calves were reared indoors until the Spring of 1972, grazed through the summer and yarded in the autumn. Liveweights were recorded at turnout to grass, at yarding and just prior to slaughter; fitness for this was decided by the farmers in the farm trials and by one man in the trials at the Colleges. Various carcase data were recorded on 174 Simmental crosses and 125 contemporaries.

From the farm trials the left sides of 17 German Simmental cross and 11 Friesian carcases were evaluated in detail by cutting into standardized wholesale joints followed by separation into lean, fat and bone. Similar data were obtained on 24 German Simmental cross Ayrshire and 25 Friesian cross Ayrshire animals from the College trials. The full results are given in Appendix 3 page 68.

Semi-intensive beef production in England

4.3 Bulls owned by the English MMB, English members of the AAIC and private breeders were used to provide calves for these trials. 210 German Simmental cross Friesian (GS×), 200 Swiss Simmental cross Friesian (SS×) and 85 Limousin cross Friesian (L×) steer calves were purchased by MLC staff and reared and finished with 518 Friesian (F) steer contemporaries on 38 farms. The farmers decided when the animals were ready for slaughter.

The cattle were weighed at turnout to grass, at yarding in the autumn and just prior to slaughter. Carcase weights were recorded for 111 German Simmental cross, 83 Swiss Simmental cross, 30 Limousin cross and 270 Friesian animals. Most of these were assessed by MLC staff for fatness, conformation and weight of kidney knob and channel fat. The left sides of 18 German Simmental cross, 13 Swiss Simmental cross, 11 Limousin cross and 3 Friesian cattle were evaluated in detail into standardized wholesale joints followed by separation into lean, fat and bone. The full results are given in Appendix 3 page 68.

Summary of results on commercial farms

4.4 Differences between the imported breed crosses and native contemporaries are given in the following tables. Data were analysed to investigate the differences between the breeds. Statistical significance between the breeds in a trial is indicated by an asterisk(s) against the Friesians or Friesian cross Ayrshire using the convention: * = $p < 0.05$, (significant), ** = $p < 0.01$ (highly significant), *** = $p < 0.001$ (very highly significant).

Results which did not meet conventional levels of significance are undesignated.

4.5 Table 4.1 gives the differences in growth rate during the finishing period. German Simmental crosses generally grew faster than the other breeds but there were only small differences between the Friesians and the Swiss Simmental and Limousin crosses.

Table 4.1 *Daily gain during the finishing period*

Trial		F or F×A (kg)	GS× or GS×A (kg)	SS× (kg)	L× (kg)	Differences as % above (+) or below (−) F or F×A		
						GS× or GS×A	SS×	L×
Intensive cereal beef		1.12***	1.20	†1.15	†1.12	+7.7	+1.2	−1.2
Semi-intensive beef	Scottish farms	0.88***	1.03	—	—	+17.7	—	—
	Scottish Colleges	0.75**	0.81	—	—	+8.5	—	—
	English farms	0.78	0.82	0.81	0.82	+5.1	+3.8	+5.1

†Compared with F average of 1.13 kg/day; these differences were not statistically significant.

4.6 Simmental and Limousin crosses usually had higher killing out percentages (Table 4.2) than contemporary Friesian and Friesian crosses except for the animals from English farms. Limousin cross cattle had a particularly high killing out percentage in intensive systems.

Table 4.2 *Killing out percentage*

Trial		F or F×A (%)	GS× or GS×A (%)	SS× (%)	L× (%)	Differences as % above (+) or below (−) F or F×A		
						GS× or GS×A	SS×	L×
Intensive cereal beef		55.2*	55.9	†56.8	†58.2	+1.3	+0.7	+3.2
Semi-intensive beef	Scottish farms	54.9*	55.2	—	—	+0.5	—	—
	Scottish Colleges	56.5*	56.6	—	—	+0.2	—	—
	English farms	53.2	52.6	53.0	††54.5	−1.1	−0.4	−0.3

†Compared with F average of 56.4%

††Compared with F average of 54.7%

4.7 German Simmental crosses produced greater weights of carcase per day of age than did their Friesian contemporaries (Table 4.3). Swiss Simmental cross cattle and the Friesians had similar carcase weights per day of age whilst that for the Limousin cross animals was lower than the Friesians.

Table 4.3 *Carcase gain per day of age*

Trial		F or F×A (kg)	GS× or GS×A (kg)	SS× (kg)	L× (kg)	Differences as % above (+) or below (−) F or F×A		
						GS× or GS×A	SS×	L×
Intensive cereal beef		0.62***	0.65	†0.62	†0.62	+4.8	−1.6	−1.6
Semi-intensive beef	Scottish farms	0.46	0.51	—	—	+10.9	—	—
	Scottish colleges	0.46	0.49	—	—	+6.5	—	—
	English farms	0.43**	0.44	0.42	††0.40	+2.3	−2.3	−2.5

†Compared with F average of 0.63 kg/day of age
††Compared with F average of 0.41 kg/day of age

4.8 In all the trials the imported breed crosses produced carcases with markedly better conformation scores than their native breed contemporaries (Table 4.4).

Table 4.4 *Body conformation scores*[1]

Trial		F or F×A	GS× or GS×A	SS×	L×	Differences as % above (+) or below (−) F or F×A		
						GS× or GS×A	SS×	L×
Intensive cereal beef		3.2***	†4.7	3.8	3.9	+20.5	+18.8	+21.9
Semi-intensive beef	Scottish farms	2.8	3.1	—	—	+10.7	—	—
	Scottish Colleges	2.4*	2.8	—	—	+16.7	—	—
	English farms	2.8***	3.4	3.3	ø3.7	+21.4	+17.9	+37.0

[1] Based on five point scale 1 poor shape to 5 good shape
† Based on seven point scale 1 poor shape to 7 good shape and compared with a F average of 3.9
ø Compared with F average of 2.7

4.9 Simmental crosses had consistently lower external fat scores than their contemporaries indicating they could have been taken to heavier carcase weights without becoming too fat for commercial requirements (Table 4.5). The Limousin crosses had lower external fat scores than their contemporaries in the intensive trials but were similar in the semi-intensive trials.

Table 4.5 *External fat scores*[1]

Trial		F or F×A	GS× or GS×A	SS×	L×	Differences as % above (+) or below (−) F or F×A		
						GS× or GS×A	SS×	L×
Intensive cereal beef		2.3*	†2.7	2.2	2.0	−6.9	−4.3	−13.0
Semi-intensive beef	Scottish farms	2.4	2.4	—	—	0.0	—	—
	Scottish Colleges	2.7	2.5	—	—	−7.4	—	—
	English farms	2.5	2.3	2.3	2.6	−8.0	−8.0	+4.0

[1] Based on five point scale 1 leanest to 5 fattest

† Based on seven point scale 1 leanest to 7 fattest and compared with a F average of 2.9; this difference was not statistically significant.

4.10 Table 4.6 gives the weights of kidney knob and channel fat estimated by MLC staff for the different breed types. This fat deposit represents a small percentage of the carcase and in most cases there was no real difference.

Table 4.6 *Estimated weight of kidney knob and channel fat*

Trial		F or F×A (kg)	GS× or GS×A (kg)	SS× (kg)	L× (kg)	Differences as % above (+) or below (−) F or F×A		
						GS× or GS×A	SS×	L×
Intensive cereal beef		7.7	7.3	†6.4	†6.6	−4.5	−1.5	+1.5
Semi-intensive beef	Scottish farms	6.1	6.3	—	—	+4.4	—	—
	Scottish Colleges	nr	nr	—	—	—	—	—
	English farms	8.1	7.7	8.3	††5.2	−4.9	+2.5	−28.8

† Compared with F average of 6.5 kg

†† Compared with F average of 7.3 kg

nr = not recorded

4.11 German Simmental crosses generally had a higher lean meat content than their Friesian and Swiss Simmental cross contemporaries (Table 4.7) and lower total fat and bone content (Tables 4.8 and 4.9). A higher proportion of the German Simmental cross carcases was distributed in the high priced cuts than in any of the contemporaries (Table 4.10) but Limousin crosses had the least bone and the greatest eye muscle area of all the cattle (Tables 4.9 and 4.11).

Table 4.7 *Percentage lean in the carcase (excluding kidney knob and channel fat)*

Trial		F or F×A (%)	GS× or GS×A (%)	SS× (%)	L× (%)	Differences as % above (+) or below (−) F or F×A: GS× or GS×A	SS×	L×
Intensive cereal beef		60.9	62.5	nr	nr	+2.6	—	—
Semi-intensive beef	Scottish farms	61.5	64.0	—	—	+4.1	—	—
	Scottish Colleges	59.1	61.4	—	—	+3.9	—	—
	English farms	63.0**	66.6	65.7	66.6	+5.7	+4.3	+5.7

nr = not recorded

Table 4.8 *Percentage total fat in carcase (excluding kidney knob and channel fat)*

Trial		F or F×A (%)	GS× or GS×A (%)	SS× (%)	L× (%)	Differences as % above (+) or below (−) F or F×A: GS× or GS×A	SS×	L×
Intensive cereal beef		21.0	19.7	nr	nr	−6.2	—	—
Semi-intensive beef	Scottish farms	21.6	19.3	—	—	−10.6	—	—
	Scottish Colleges	24.6	22.4	—	—	−8.9	—	—
	English farms	18.2	15.6	15.9	16.3	−14.3	−12.6	−10.4

nr = not recorded

Table 4.9 *Percentage bone in carcase (excluding kidney knob and channel fat)*

Trial		F or F×A (%)	GS× or GS×A (%)	SS× (%)	L× (%)	Differences as % above (+) or below (−) F or F×A		
						GS× or GS×A	SS×	L×
Intensive cereal beef		15.3	15.1	nr	nr	−1.3	—	—
Semi-intensive beef	Scottish farms	15.3	14.9	—	—	−2.6	—	—
	Scottish Colleges	14.7	14.5	—	—	−1.4	—	—
	English farms	17.4**	16.5	17.0	1.56	−5.2	−2.3	−10.3

nr = not recorded

Table 4.10 *Percentage high priced cuts in carcase (excluding kidney knob and channel fat)*

Trial		F or F×A (%)	GS× or GS×A (%)	SS× (%)	L× (%)	Differences as % above (+) or below (−) F or F×A		
						GS× or GS×A	SS×	L×
Intensive cereal beef		43.9	44.1	nr	nr	+0.5	—	—
Semi-intensive beef	Scottish farms	42.7	43.4	—	—	+1.6	—	—
	Scottish Colleges	42.7	43.3	—	—	+1.4	—	—
	English farms	45.2*	46.7	46.1	46.2	+3.3	+2.0	+2.2

nr = not recorded

Table 4.11 *Eye muscle area (sq cm)*

Trial		F or F×A	GS× or GS×A	SS×	L×	Differences as % above (+) or below (−) F or F×A GS× or GS×A	SS×	L×
Intensive cereal beef		56.7	62.9	nr	nr	+10.9	—	—
Semi-intensive beef	Scottish farms	71.0	78.0	—	—	+9.9	—	—
	Scottish Colleges	63.0	68.0	—	—	+7.9	—	—
	English farms	60.0	63.7	62.6	65.9	+6.2	+4.3	+9.8

nr = not recorded

The full results of the trials in intensive feeding are in Appendix 2 page 63, and those for the semi-intensive feeding in Appendix 3 page 68.

Growth rates of suckled calves

4.13 Limousin and Simmental cross calves were weighed in 344 MLC recorded suckler herds where they were reared alongside contemporary calves sired by Aberdeen Angus, Charolais, Devon, Hereford, Lincoln Red or South Devon bulls. The number of weighings of calves by each sire breed within two days of birth and within 49 days of 200 and 300 days of age, respectively, and birth weights and adjusted 200 and 300 days weights for each of the sire breeds are presented for lowland, upland and hill herds in Appendix 4 Table A4.3 page 77.

4.14 The results for the established breeds confirm previous MLC findings. The Charolais sired calves had the heaviest weights at every stage followed by those by the South Devon, Devon, Lincoln Red, Hereford and Aberdeen Angus. Calves sired by Simmental bulls were lighter than Charolais crosses, but similar in weight to South Devon crosses at birth, 200 and 300 days. Limousin crosses were similar in weight to Lincoln Red crosses at birth, intermediate in weight between Lincoln Red and Hereford crosses at 200 days and slightly heavier than Lincoln Red crosses at 300 days. These patterns of performance were repeated in the three herd locations, but with a progressive decline in weight-for-age from the lowland to the hill environment.

4.15 When calf weights are analysed by sire breed and herd location there is a possibility of bias in the results caused by individual herd effects. This can be overcome by use of the 'contemporary comparison' in which calves sired by each breed are compared with contemporary Hereford cross calves in the same herd.

The results presented in Table 4.12 confirm that Simmental crosses had almost identical performance to South Devon crosses and Limousin crosses performed at a similar level to Lincoln Red crosses.

Table 4.12 *Contemporary comparison of calf weights in recorded lowland, upland and hill herds (kg)*

Age	Birth	200 days	300 days
Sire breed	kg above (+) or below (−) Hereford crosses		
Charolais	+5.9	+15.4	+21.3
South Devon	+5.4	+11.8	+18.1
SIMMENTAL	+5.0	+12.7	+18.1
Devon	+3.2	+9.1	+13.2
Lincoln Red	+3.2	+8.2	+12.7
LIMOUSIN	—ø	+7.7	+15.0
Hereford	0.0	0.0	0.0
Aberdeen Angus	−3.6	−14.1	−19.1

ø Insufficient results for analysis

4.16 MLC has collected data on the subsequent growth rates and slaughter weights for suckled calves. The cattle were finished in yards and slaughtered at about 16–20 months of age (Table 4.13).

Table 4.13 *Subsequent daily liveweight gains and average slaughter weights of suckled calves*

Sire breed	No. of animals	Av daily liveweight gain (kg)	Gains above (+) or below (−) Hereford crossesø (kg)	Av slaughter weights (kg)	Weights above (+) or below (−) Hereford crossesø (kg)
Charolais	1,078	0.85	+0.14	454	+33
South Devon	378	0.82	+0.09	451	+30
SIMMENTAL	326	0.82	+0.09	449	+30
Devon	365	0.77	+0.05	447	+18
Lincoln Red	458	0.77	+0.05	442	+15
LIMOUSIN	227	0.73	+0.05	433	+16
Hereford	3,336	0.68	0	420	0
Aberdeen Angus	2,100	0.64	−0.09	398	−18

ø Contemporary comparison with Hereford crosses

The Simmental crosses continued to grow at similar rates to the South Devon and Charolais crosses and faster than the Hereford crosses. Slaughter weights for these breeds were also higher than for Hereford crosses. Growth rate and slaughter weight of the Limousin cross cattle was similar to those of Devon and Lincoln Red crosses and greater than the Hereford cross contemporaries.

Milk yield and quality of purebred and crossbred Simmentals

4.17 Table 4.14 gives the average of the first lactation records of 13 purebred and 114 crossbred daughters of the German and Swiss Simmental bulls imported in 1970/71.

Table 4.14 *Milk yield and quality of the pure and crossbred daughters of Simmental bulls*
Purebred

Lactation number	Number of daughters	Average age (months)	Milk yield (kg)	Lactation length (days)	Butterfat %	Weight of butterfat (kg)	Protein %
1	13	28 (11)	3,011	282	3.95	119	3.60 (2)
2	3	38	3,627	295	3.76	136	3.24 (1)

Crossbred

Lactation number	Number of daughters	Average age (months)	Milk yield (kg)	Lactation length (days)	Butterfat %	Weight of butterfat (kg)	Protein %
1	114	28 (113)	3,230	286	3.80	123	3.36 (62)
2	3	36	4,134	303	3.80	157	3.20

The figures in brackets refer to the number in that average.

Of the 114 crossbred daughters, 3 were out of Jersey dams, 3 out of Guernsey, 36 out of Dairy or Northern Dairy Shorthorns, 1 out of Danish Red and 6 from dams of undefined breed type whilst the remaining 65 were from Friesian or Ayrshire cows. It must be understood that pures and crossbreds were not milked in the same herds, nor necessarily in the same seasons, therefore no conclusions can be safely made.

5 The production trial at Experimental Centres

5.1 This trial was carried out especially to obtain data on feed conversion efficiency and detailed carcase composition of the three imported breed crosses, German Simmental cross Friesian (GS×), Swiss Simmental cross Friesian (SS×) and Limousin cross Friesian (L×), compared with purebred Friesian (F) and Hereford cross Friesian (H×) the most common types of beef cattle produced in Britain. All the individual feeding facilities at four Ministry of Agriculture, Fisheries and Food (MAFF) Experimental Husbandry Farms (EHFS), Boxworth, Drayton, High Mowthorpe and Liscombe, as well as those at the Norfolk Agricultural Station (NAS) were used.

5.2 MLC supplied the centres with groups of crossbred male calves by each of the imported breeds out of Friesian cows. An attempt was made to distribute the progeny of each bull uniformly over the centres. This was most fully achieved with Limousin and to a lesser extent with Simmental bulls. At the same time the centres bought pure Friesian and Hereford cross Friesian male calves from their normal suppliers; it is possible that the samples of these breeds differed genetically between centres. All five breed types were, however, represented in equal numbers at all five centres but the total at each centre depended on the individual feeding facilities available.

5.3 In this experiment all the animals were fed individually throughout life. They received the same milk substitute until the normal weaning age for the farm. Thereafter they were fed ad libitum, first on the same proprietary rearing nuts until 12 weeks of age and then on the same complete pelleted diet consisting of 65% lucerne, 33% barley and 2% of a vitamin and mineral mixture. The animals consumed some 450 tonnes of the diet which was made to specification in a two week period to minimise variations in composition. The diet had an average 'in vivo' D value of 63. The animals were offered 0.5 kg per head per day of hay or straw to help counteract bloat problems.

5.4 In order to obtain data from each breed type over a range of age, weight and fatness, representative samples of the animals were serially slaughtered after one of four previously determined periods at each centre. The Hereford crosses were slaughtered after 12, 12¾, 13½ and 14¼ months on the farm, the Limousin cross cattle after 12, 13, 14 and 15 months and the German and Swiss Simmental crosses and Friesians after 13, 14, 15 and 16 months.

5.5 The left side of each carcase was fully dissected into lean, fat and bone by the Meat and Livestock Commission.

5.6 Experience has shown that if different breeds are slaughtered according to subjective estimates of degrees of finish, one breed may be more mature at slaughter than another. Direct comparisons are then of little value. Serial slaughter was adopted to avoid this situation and allow calculation of the relationships between slaughter weight and carcase composition so that comparative estimates could be produced either at the same slaughter weight or at the same degree of finish. Unfortunately the correlation coefficients (r) between slaughter weight and per cent fat were low (r varied from 0.3 to 0.5 depending on breed type) and predictions based on them are subject to error. In other words animals slaughtered at the same weight varied considerably in carcase fatness, whilst at a given degree of fatness animals varied considerably in slaughter weight.

5.7 Table 5.1 shows the estimates for a common weight of 430 kg. The Hereford cross cattle at this weight would have a greater content of fat than the other breeds but there would be no major differences between the other four breeds.

Table 5.1 *Estimated breed values at a standard liveweight at slaughter (430 kg) obtained from regression analysis*

	F	H×	L×	GS×	SS×
Age at standard weight (days)	424	437	443	400	414
Killing out % excluding KKCF ø	52.5	52.9	54.9*	51.6	52.3
Cold carcase weight excluding KKCF (kg)	226	227	236*	222	225
KKCF as % of cold carcase weight including KKCF	4.1	3.3*	3.3*	3.6	3.5
As % of cold carcase weight excluding KKCF					
Lean	60.4	57.6*	63.3*	62.4	60.5
Bone	16.4	15.0**	14.5**	16.1	15.9
Total fat	19.9	24.1**	18.9	19.0	19.6
Subcutaneous (external) fat	6.9	10.1*	6.9	6.4	6.9
Weight of lean (kg)	136.3	131.0*	149.4**	138.5	135.9
Eye muscle area 13th rib (sq cm)	58	60	72**	62*	61

ø KKCF = Kidney knob and channel fat.
The levels of significance indicated refer to comparison with Friesians.

The most striking feature of the data in Table 5.1 was the evidence that Limousin crosses would have the highest carcase percentage, the highest percentage of lean, the greatest weight of lean, the lowest percentage of bone and the largest eye muscle area.

5.8 The relationships were then used to prepare estimates of the most likely weight for each breed at a common fat per cent in the carcase of 20% (excluding KKCF). These are shown in Table 5.2.

Table 5.2 *Estimated breed values at 20% total fat in the carcase (excluding* KKCF ø*) obtained from regression analysis*

		F	H×	L×	GS×	SS×
Age at slaughter (days)		428	348	467	450	434
Liveweight at slaughter øø	(kg)	434	350	469	478	449
Killing out % excluding KKCF		52.5	51.4	55.7	52.5	52.6
Cold carcase weight excluding KKCF	(kg)	228	180	261	251	236
KKCF as % of cold carcase weight including KKCF		4.2	2.7	3.5	4.0	3.8
As % of cold carcase weight excluding KKCF						
Lean		60.3	60.6	62.7	61.0	60.1
Bone		16.3	15.9	14.2	15.6	15.6
Subcutaneous (external) fat		6.9	7.5	7.3	7.1	7.0
Weight of lean	(kg)	137.4	109.1	163.6	153.0	141.8
Eye muscle area 13th rib (sq cm)		59	53	76	67	63

ø KKCF = Kidney knob and channel fat

øø The residual standard deviation per animal varied from 25 to 30 kg.

These show that while the Hereford crosses would then be expected to reach 20% fat, on the diet offered, at 350 kg weight and in about 350 days the other breeds or crosses would be about 430–480 kg weight and would take 430–480 days to reach that stage of maturity. Killing out % would be similar except for Hereford crosses which would be somewhat lower and Limousin cross cattle which would be substantially higher.

5.9 As a separate check the estimated weights for each breed or cross to reach 40% of the expected mature weight of the corresponding breed or cross of bull was calculated. The weight of the cross was assumed to be the average of those of the parent breeds. These would give values of Friesian 440 kg, Hereford 400 kg, Limousin 420 kg, German Simmental 440 kg and Swiss Simmental 440 kg, figures in reasonable agreement with Table 5.2. See footnote Page 36.

5.10 Comparisons of carcase composition at an estimated 20% fat show that the Limousin crosses would be expected to have a higher lean and consequently lower bone per cent than the other breeds and that the Friesians would tend to have the lowest lean and highest bone content.

As a result of these differences in carcase composition Limousin crosses would yield more lean meat than Simmental crosses and the evidence from eye muscle area suggests that Limousin crosses would also show the thickest muscling and Hereford crosses the least.

Two further aspects of the fat content should be mentioned. The first is that Hereford cross animals would be expected to have somewhat under a half of their total fat as subcutaneous fat whilst the proportion is only about one third for the other four types. Secondly, despite their high total fat content, Hereford crosses carried no more of this as kidney knob and channel fat than did Limousin crosses; both were significantly lower than the Friesians. This analysis confirmed previous studies which show that Friesian cattle carried a much larger proportion of kidney knob and channel fat than did Hereford crosses.

5.11 It will be recalled that progeny of the five Limousin bulls were almost equally distributed over all five centres whilst the Friesians and Hereford crosses could have differed genetically. Limousin crosses consumed similar amounts at all centres but there was some variation in food consumption between Friesians and, to a lesser extent, Hereford cross cattle at the different centres.

These limitations on the comparisons of feed efficiency should be borne in mind when considering the estimates in the table below.

5.12 Feed conversion efficiency is best compared when the breeds are at a similar level of fat content in the carcase. The data in Table 5.3 show that whether measured per kg liveweight at slaughter, cold carcase weight or lean, the Hereford crosses would require the least amount of feed closely followed by the Limousin cross cattle, while the Friesians would show the poorest efficiency of feed conversion. Moran (1976) noted the poor efficiency of Friesians and Holsteins in feed conversion to lean meat, compared with breeds selected for beef characteristics, to be a consistent finding in his review of the literature on breed comparisons.

The percentage of estimated mature weight has been suggested as a suitable basis for comparing breeds. Moran (1976) reviewing the literature noted that optimum slaughter weights recommended by Kay *et al.* (1974) for cereal beef for all breeds fell within the range 35–39% (mean 37%) of mature weight and the corresponding weights for grass cereal beef (Baker *et al.* 1971) within the range 43–50% (mean 46%) of mature weight.

Table 5.3 *Estimated breed values for food consumption and efficiency at 20% total fat in the carcase (excluding KKCF ø) obtained from regression analysis*

		F	H×	L×	GS×	SS×
Total	(kg)	2,863	1,926	2,974	3,380	2,822
Per kg liveweight slaughter	(kg)	6.6	5.5	6.3	6.5	6.3
Per kg cold carcase weight excluding KKCFø	(kg)	12.6	10.7	11.4	12.1	12.0
Per kg lean	(kg)	20.8	17.7	18.2	19.9	19.9

ø KKCF =Kidney knob and channel fat.

5.13 Some factors in the comparison did not vary with weight at slaughter. For these the overall estimate is the best measure. These figures are shown in Table 5.4.

Table 5.4 *Overall breed averages*

	F	H×	L×	GS×	SS×	se per animal
Growth rate (kg/day)	0.93	0.90	0.89	0.96	0.94	0.16
% High priced cuts	45.7	45.9	46.8**	45.7	45.9	0.23
Lean in high priced cuts as % of total lean	49.2	49.2	50.5**	49.3	49.6	0.23
Lean/bone ratio	3.7	3.8	4.3**	3.9	3.9	0.05

The levels of significance indicated relate to comparisons with the Friesian only.

The growth rate of the Friesian cattle was not significantly different from any other breed though German Simmental crosses grew significantly faster ($p < 0.05$) than the Hereford and Limousin crosses.

For the carcase characters Limousin cross cattle were significantly superior to Friesians and also were consistently better than the other three types. The lean/bone ratio of this cross was particularly high whilst those of the others were similar.

5.14 Sample joints obtained from the imported breed crosses from two of the centres were studied at the Meat Research Institute. In general no differences were found between the crosses, or between them and the normal levels expected in steers of this age for flavour, texture and juiciness of lean, or overall acceptability.

5.15 The full results of this trial are given in Appendix 5 page 78.

6 Discussion

Introduction

6.1 The investigations covered in this report refer to a major study to compare two imported cattle breeds with contemporary British cattle. It was conducted in a co-ordinated manner and included the major organisations concerned with cattle production in Britain. A considerable amount of experience was gained in addition to the actual data. In this discussion an attempt is made to review the results and to distil the experience.

Reference should first of all be made to the scale of the whole operation (Table 6.1). If relatively small but important economic differences are to be detected large numbers of animals are required, and even then, such is the variability of animals and of farming systems that a considerable range of results must be expected. Our purpose was to identify any major differences in performance characters which might result from the use of the imported breeds.

6.2 The results are considered under three main headings. These are the results of calving surveys, the growth and carcase results collected from farms and the data on growth, carcase and feed utilization from Experimental Centres. An attempt is then made to combine these results in an economic evaluation. Finally the design and conduct of any subsequent breed evaluations are discussed.

The surveys on calving performance

6.3 Although the types of cow and methods of conducting the surveys differed in detail so that the results cannot be precisely compared the surveys on dairy cattle, conducted under the aegis of the Committee, together with the more recent results of the survey on beef cows, conducted by the Meat and Livestock Commission (and summarised in Sections 3.11 to 3.13), agree in the orders of rank which are allocated to the tested breeds in comparison with established breeds in Britain. Whether in calf mortality or calving difficulty the Simmental breed as a whole gave figures similar to those of the Charolais while the Limousin crosses resulted in less mortality and calving

Table 6.1 *Number of animal records in the co-ordinated trials*

	By German Simmental bulls			By Swiss Simmental bulls			By Limousin bulls			By contemporary native breed bulls		
Calving reports	4,466			2,561			1,497			25,323		
Growth rates in suckler herds	1,636						528			11,464		
Production trials	Growth records	Carcase weights	Dissections	Growth records	Carcase weights	Dissections	Growth records	Carcase weights	Dissections	Growth records	Carcase weights	Dissections
Intensive cereal beef	146	104	20	95	79	—	48	40	—	293	212	15
Semi-intensive—commercial farms in Scotland	110	87	17	—	—	—	—	—	—	75	49	11
Semi-intensive—Agricultural Colleges in Scotland	87	87	24	—	—	—	—	—	—	76	76	25
Semi-intensive—commercial farms in England	115	111	18	132	83	13	51	30	11	332	270	3
Experimental centres	25	25	25	24	24	24	26	26	26	57	57	57
Totals in production trials	473	414	104	251	186	37	125	96	37	833	664	111

Carcase weights on 1,360 animals
Dissection of left sides of 289 animals

difficulty but still tended to be less satisfactory than the Hereford. These rankings agree with studies in other countries (Mason, 1971), from USA (Laster *et al.* 1973) and from Denmark (Bech Andersen *et al.* 1974). Higher calf birthweights were associated with the heavier breeds. There were increased problems associated with heifer calvings.

6.4 Breed averages conceal a wide variation between bulls, and possibly between regional groupings of cows. The Artificial Insemination Organisations have evaluated each bull for the incidence of calving difficulties so that bulls which created unusual problems have been identified and eliminated.

The routine assessment of the incidence of calving problems from new bulls is an important aspect of cattle breeding management. We consider that the methods used should be clearly and objectively defined so that comparable data can be assembled on all new bulls as they enter AI breeding studs. Precise measurement is more difficult for farmer owned bulls used within only one or two herds, but we believe that breeders are alert to this problem.

The assessment of growth rates on farms

6.5 Growth rates of the progeny of the new breeds recorded on commercial farms and compared with indigenous pure Friesian or Friesian cross Ayrshire cattle give a measure of performance under practical farm conditions. These results have been described in Chapter 4. The economic importance of growth rate has been stressed in MLC surveys. The differences recorded have been expressed as percentages to facilitate comparison. It will be appreciated that such figures are of varying statistical validity. Table 4.1 shows that the progeny of German Simmental bulls consistently exceeded the growth rate of Friesian (or Friesian cross Ayrshire) contemporaries in each trial by from 4–17%. There were fewer data for Swiss Simmental and Limousin crosses and the differences recorded were small.

6.6 There was no evidence that the advantage of German Simmental progeny relative to Friesians was greater on any particular feeding system. The contemporary comparisons of the performance of beef cattle crosses also did not give any evidence of a breed/environment interaction. When carcase gain per day of age was compared the German Simmental crosses were again consistently superior particularly in Scotland. Body conformation scores of all crosses were consistently better than those of Friesian cattle and internal fat scores tended to be lower. These results emphasised the difficulty of visually assessing body condition. There was a common tendency for cattle from the imported breeds to be slaughtered when they carried less subcutaneous fat. This was confirmed by the limited number of carcase dissections which indicated that German Simmental crosses consistently had a higher lean percentage and lower fat percentage than Friesian contemporaries. Unfortunately few carcase assessments were made on the progeny of Swiss Simmental or Limousin bulls in the trials on commercial farms.

These data on growth and carcase composition are in general agreement with other published records (Bech-Andersen *et al.* 1974 and US Meat Animal Research Center 1974).

Growth and feed utilisation

6.7 Growth rate and carcase composition are only two components in the evaluation of meat producing animals. The quantity of feed required for production is a most important criterion. This is extremely difficult to measure on commercial farms even with cereal feeding and is virtually impossible in grass feeding conditions. The data from the Experimental Centres are therefore valuable in that feed consumption was recorded individually for some 115 cattle including contemporary Friesian and Hereford cross Friesian cattle.

6.8 The data obtained from these trials demonstrated that at the same liveweight the Hereford cross cattle were much more mature than the Friesians or the crosses by the imported breeds. These results emphasised the importance of making comparisons of different breeds of cattle at similar degrees of maturity. The expected results at similar levels of carcase fat percentage give a biologically more satisfactory basis for comparing the crosses. These indicated that although there was a common dam breed, the Friesian, there would be differences in expected slaughter weight from 350 kg for the Hereford crosses to 470 kg for the Limousin crosses. In these circumstances the latter crosses would be expected to yield the highest lean percentage in the carcase and the lowest bone content.

The data on feed utilisation indicate that the Hereford crosses closely followed by Limousin crosses would be the most efficient producers of lean meat and the Friesians the least. Other comparisons of efficiency of meat production have also shown the Friesians to be less efficient meat producers than the beef breeds such as the Charolais and Hereford (Lindhe and Henningson, 1968). The data from the US Meat Animal Research Center show no differences between crosses by Charolais, Hereford, Limousin and Simmental bulls in feed efficiency (US Meat Animal Research Center 1974).

6.9 Since these investigations began the Meat and Livestock Commission has established two breed evaluation units, one at Ingliston in Scotland and one at Sutton Bonington in England. In these an attempt has been made to slaughter cattle at comparable levels of finish by the assessment of backfat thickness by electronic scanning although this does not take account of differences between breeds in the ratio of backfat to total carcase fat (Callow, 1961).

Although MLC has stressed the need for more data to be accumulated before a final decision is made the first data from the Sutton Bonington centre are reasonably comparable to those produced at the Experimental Centres (Exp. C.). They are compared in Table 6.2 in which the estimated values for Experimental Centre cattle at 20% fat excluding KKCF are compared with the MLC data from cattle selected on the basis of the scanogram to give an average of MLC fat class 3. Limousin crosses were not included in the MLC evaluations initially.

Table 6.2 *Comparison of Experimental Centre and* MLC *16 month results*

	F	H×	S×
Estimated weight at slaughter (kg)			
Exp. C. 20% fat	434	350	464
MLC fat class 3	448	409	491
Estimated age at slaughter (days)			
Exp. C. 20% fat	428	348	442
MLC fat class 3	490	415	489
Estimated feed per kg liveweight gain			
Exp. C. 20% fat	6.6	5.5	6.4
MLC fat class 3	6.3	5.0	5.3
Daily gain (kg)			
Exp. C. 20% fat	0.93	0.90	0.95
MLC fat class 3 (from 3 months)	0.91	0.91	1.00

Integration of the results into an economic evaluation

6.10 As indicated in Chapter 1 the Committee intended that the overall effect of the imported breeds on British cattle systems should be assessed. Cunningham (1974) considering this subject suggested that the three main economic traits affecting beef production were: the probability of survival of the calf, the growth rate of the calf and the proportion of meat in the carcase. In Chapter 1 we set out a number of factors which we considered to be of importance in breeding and feeding of beef cattle. In the following assessment we have endeavoured to incorporate most of the factors listed in Chapter 1 and the results obtained in our studies. Mean values have been used. It is accepted that some variation would occur around the mean values but they would to some extent compensate each other. Prices relate to those in Britain in 1976.

The results of our evaluations are summarised in the following sections and more details of the estimates are given in Appendix 6 Page 95.

Breeding

6.11 The evidence available to us indicates that the bulls of the imported breeds gave satisfactory conception rates. Differences existed in gestation length which we suggest are valued at 60p per day. If calves were valued at £25–£50 a change of 1% in calf mortality represents 25p–50p per surviving calf. We suggest that cow deaths associated with difficult calvings might cost some 25p–30p per surviving calf and that other direct costs of 'difficult calvings' might result in a charge of 50p per surviving calf per 1% incidence of dystokia and of 5p per surviving calf where 'some assistance' was required.

In addition calving difficulties result in considerable disturbances to the cow, the stockman and the farmer. We do not attempt to put a monetary value on this but we consider that this intangible factor may often determine whether a farmer continues to use a particular breed or particular bull.

In addition there is a premium for calves which are colour marked by breeds recognised as being superior eg Hereford or Charolais. For example Hereford cross Friesian calves command a premium of the order of £10–£20 over pure Friesians and allowance must be made for this. We accept that the users of some breeds are now developing schemes which identify the progeny of non colour marking bulls but the organisation and administration of such schemes also incurs cost.

6.12 In summary therefore breeding effects are valued as shown below:

Difference in gestation length	60p per day
Incidence of calf mortality	25p–50p per surviving calf per 1% mortality
Cow death associated with calving	25p–30p per surviving calf per 1% dystokia
Dystokia (direct costs)	50p per surviving calf per 1% dystokia
Some assistance at calving	5p per surviving calf per 1% dystokia
Colour marking	£10–£20 per calf.

6.13 These effects on breeding have been compared in Appendix 6 by estimating the performance from Hereford and imported bulls, crediting the calf birthweight at 55p per kg and making the allowances and deductions shown in 6.12. These estimates suggest that additional costs associated with breeding would almost offset the advantages of Limousin or Simmental bulls compared with Hereford bulls. If allowance was made for colour marking this would favour the Hereford to the greatest extent.

Feeding

6.14 The economic value of several components of feeding systems have also been assessed and details are included in Appendix 6.

6.15 Our data gave no strictly comparable data on the ease of rearing of calves sired by the imported breeds compared with native breeds.

6.16 In comparing growth and feed utilisation of the weaned calf, account should be taken of growth rate, time to finish, feed used per kg gain and the carcase yield. These we consider are most effectively compared by taking standard values per kg for feed and carcase weight, and by assessing a margin of carcase value over cost of calf and feed. This margin (which must not be confused with gross margin or with net profit, since it must cover the other variable costs and the common costs including labour, rent and interest on capital before a profit is attained) can then be compared per animal, per animal per day and per unit area required to provide feed. These comparisons, based on the data from Chapters 4 and 5, are shown in Appendix 6.

6.17 The data from the Experimental Centres trial, described in Chapter 5, give the most comprehensive information. From the data for carcases with 20% fat (excluding KKCF) with an estimated feed price of £55 per tonne and a carcase value of £1 per kg, we estimate that the margins (as defined above) in Table 6.3 would be obtained.

Table 6.3 *Comparison of margins per head, per day and per hectare*

	F	H×	L×	GS×	SS×
Margin per head (£)	47	54	74	60	57
Margin per day of age (p)	11.0	15.5	15.8	13.3	13.1
Margin per hectare for feed (£)	131	224	199	158	162

The Limousin crosses then show the highest margin per head and per day but they are second to the Hereford crosses in terms of margin per unit area required for feed. This assumes equal utilisation of feed. In practice the success of large breeds such as Friesian cows and Charolais beef crosses, has of course derived in part from the increase in effective stocking rate which has often resulted from their use.

6.18 A somewhat similar comparison was made with the farm data from Chapter 4 for intensive cereal beef. For this a feed price of £75 per tonne was assumed and again a carcase value of £1.00 per kg. The results in Table 6.4 show the Limousin crosses to be superior in margin per head and per day of finishing to the Simmental crosses which in turn exceeded the margins from Friesians.

Table 6.4 *Estimated margin per head and per day of finishing period (Farm cereal beef trials)*

	F	GS×	F	SS×	L×
Margin per head (£)	41	44	42	48	55
Margin per day of finishing period (p)	16.0	18.2	17.9	20.9	22.8

6.19 Detailed evaluation was not possible from the farm data on semi-intensive beef production. Carcase value per day of age at 47.3p for German Simmental crosses exceeded the average figure for contemporary Friesians of 44.6p. In this comparison Limousin crosses did not differ from contemporary Friesians or Swiss Simmental cross cattle.

6.20 We have endeavoured in the preceding paragraphs and in Appendix 6 to spell out in detail the many interacting factors involved in the evaluation of a cattle breed. We are quite aware that these estimates are subject to criticism of the magnitude of the differences and of the values attributed to each component. However by attempting to define and quantify each component in Appendix 6 we hope we have drawn attention to the complexity of such comparisons and to the importance of considering the whole system and not one isolated facet of cattle production.

6.21 In summary therefore it would appear that Simmental bulls might yield additional returns compared with Herefords of about £1.50 per calf from the breeding aspect whilst the returns per head from feeding would exceed those from the Hereford crosses by about £5. The Limousin crosses would again yield about £1.50 per calf as a breeding advantage but appear to bring carcase returns which exceed the Friesians (on cereal beef) or the Hereford crosses (on the dried lucerne/barley diet) by £15–£20 per head.

A feature of even more importance however is the evidence that when time or area are considered the Hereford tends to equal or exceed the margin per day and per hectare of feed from any of the larger breeds studied.

The efficiency of the evaluations

6.22 When these evaluations were planned it was agreed that tests should take place on farms and in addition in experimental centres where closer control could be exercised. There is no doubt that for calving characters there is no alternative to farm recording. As we have already stated this should be standardised, made as objective as possible and conducted as a routine measure by the AI Organisations. We believe that considerable progress towards this aim has been made in recent years.

6.23 If new breeds are to be used in practice it is axiomatic that they should also be tested in farm conditions. This ensures that they are exposed to the normal vagaries of climate, feeding regime and management and are assessed by a large number of practising farmers. Such operations as we have conducted were however difficult and expensive and were subject to a great deal of wastage. Identification of suitable calves, agreeing a price to seller and buyer and transport to the rearing farmer all made heavy demands on the time of staff from AI Organisations and MLC. We believe that co-operating farmers genuinely attempted to standardise conditions and to maintain the comparisons but a number of animal records were lost because the farmer's normal commercial operations dictated changes in plan. Moreover the selection of cattle for slaughter depended on the judgement of the farmer and his buyer and as the data in Chapter 4 indicate there was a tendency to over-estimate the condition of the imported cross breeds. Although carcase dissections were made on a number of farm cattle it was impossible to relate these accurately to feeding and management on the farms.

If such an operation were repeated we consider that it should be on a limited number of farms with large breeding herds whose owners were prepared to raise and finish the cattle in comparable conditions.

It should be stressed that on farm trials cannot be conducted 'on the cheap'. Future organisers should be prepared to allot full time personnel for liaison and supervision. Provision should also be made to recompense co-operating farmers for losses which they may incur.

6.24 The conduct of the trials on Experimental Centres yielded valuable data and there was merit in the replication of the trial at several centres. But ideally each treatment should have been replicated within each farm. There was the probability that control (F and H ×) animals differed genetically between farms and uniform representation of all bulls over all farms should be achieved in any subsequent trials. There were also differences in feeding facilities and feeding systems between farms and complete co-ordination of feeding procedures would have been preferable.

Finally, in an attempt to minimise the costs the spread of slaughter ages chosen was rather narrow. It is certain that a wider range of slaughter age and weight would have been preferable and that more animals should have been in the first and last batches to be slaughtered so that the extremes of carcase composition were better defined. It is possible that the concept of percentage mature weight would be useful in this connection and we would suggest that cattle should be slaughtered in at least 3 batches over the range from 35 to 45% of mature weight. Fully recorded data such as these deserve full attention in carcase analyses and we would recommend that such facilities be organised for any future trials.

For closely controlled feed recorded studies we would recommend that breed group sizes should be such that at least 30 completed records should be obtained although smaller numbers might be justified in a preliminary screening of a large number of breeds.

6.25 In the future many of the breed evaluations will be conducted at the MLC evaluation units. We recommend that serial slaughter be adopted for all new breeds. We consider that further attention is needed to ensure that suitable diets are developed which both simulate practical conditions and are readily measurable. The precision of feed recording requires constant vigilance. In all such studies full use of the feed records are needed so that assessments of the appetite of the cattle, and of the changes in feed utilisation as the animal matures can be recorded.

6.26 An important side issue from the present Experimental Centre data was the evidence that over the finishing period in the trial some 15–20 kg of feed were consumed per kg of carcase gain. Per kg of lean the quantities of feed consumed were 45 (F), 37 (H×), 28 (L×), 33 (GS×) and 42 kg (SS×).

Other assessments by farmers

6.27 During the evaluations progress reports were issued as soon as possible. These were referred to in the farming press. In addition many farmers were able individually to assess the value of the new breeds.

The use of bulls through AI is an indication of the interest taken by the industry. The data in Table 6.5 illustrate the situation in Britain from 1970/71 and provide a comparison with the corresponding period after the introduction of the Charolais. The Limousin demand has been far below that of the Charolais but the Simmental demand has been comparable. These figures may be put in perspective from the data on overall breed demand in AI in England and Wales, shown in Table 6.6. The Simmental in 1974/75 contributed a larger proportion of inseminations than did the Charolais in 1964/65, but the proportion is still low and there has in fact been a decline since 1974/75.

Table 6.5 *Breed preferences in inseminations* (*Great Britain*)ø
First inseminations '000—England, Wales and Scotland

	1970/71	1971/72	1972/73	1973/74	1974/75	1975/76 (provisional)
Aberdeen Angus	152	145	144	130	121	117
Charolais	129	129	143	175	145	122
Hereford	575	537	465	474	531	510
Limousin	—	6	12	16	16	12
Simmental	11	42	70	89	70	46

The corresponding data for the introduction of Charolais in the 1960s ('000 inseminations)ø

	1962/63	1963/64	1964/65	1965/66	1966/67	1967/68
Charolais England, Wales and Scotland	48	36	37	67	96	97

Table 6.6 *Percentage of breed demand in artificial insemination* (*Great Britain*)ø

	1964/65	1973/74	1974/75	1975/76 (provisional)
Friesian	47.1	57.9	54.5	57.2
All dairy breeds	62.3	63.0	60.0	63.2
All dual purpose breeds	3.0	1.6	1.5	1.2
Aberdeen Angus	8.6	4.9	5.0	4.9
Charolais	1.6	6.6	5.9	5.1
Hereford	21.4	17.9	21.8	21.3
Limousin	—	0.6	0.7	0.5
Simmental	—	3.3	2.9	1.9
All beef breeds	34.7	35.4	38.5	35.6

ø Source—UK Dairy Facts and Figures, MMB Production Division Reports and MMBS in England and Scotland

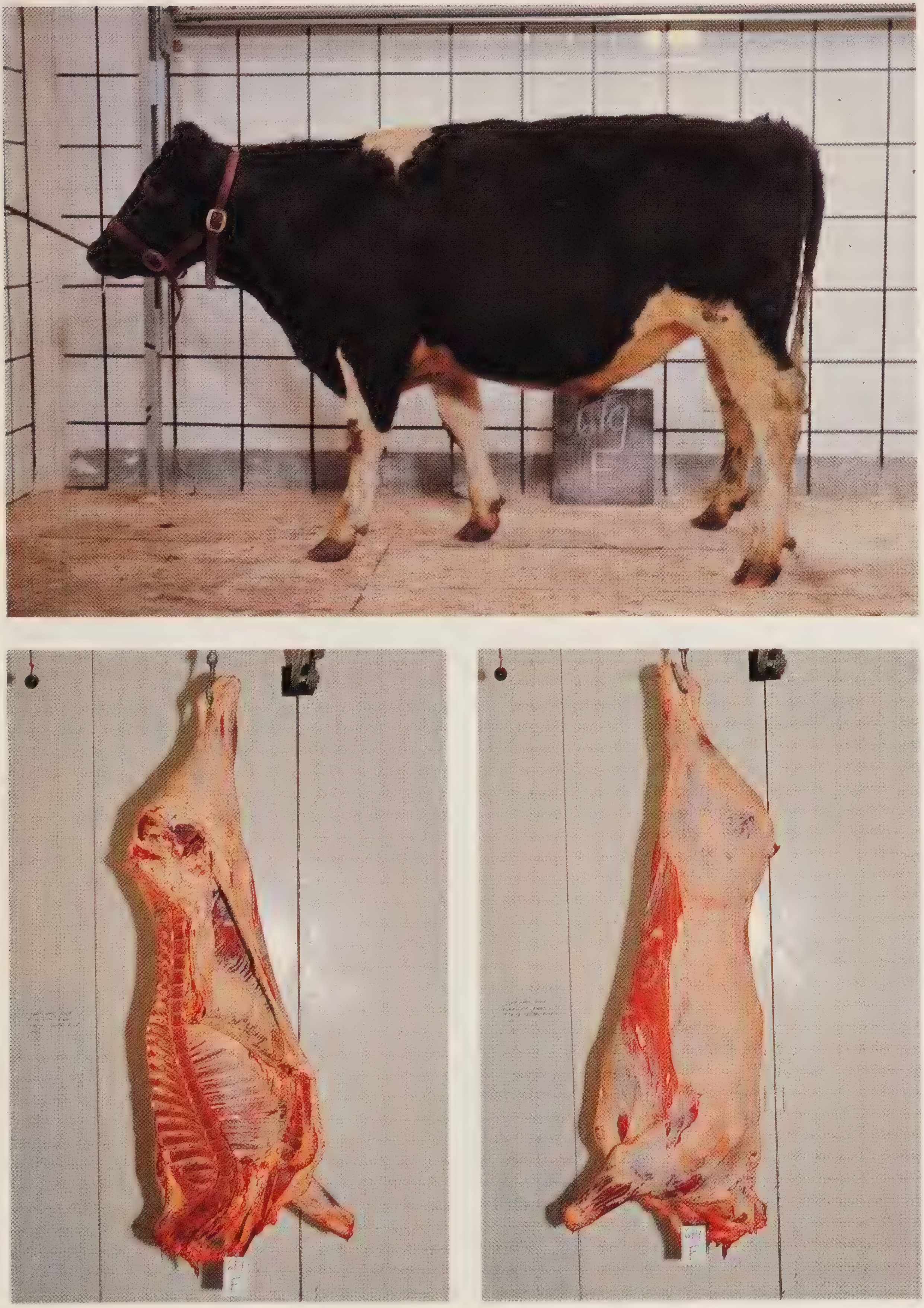

Plate 1 FRIESIAN

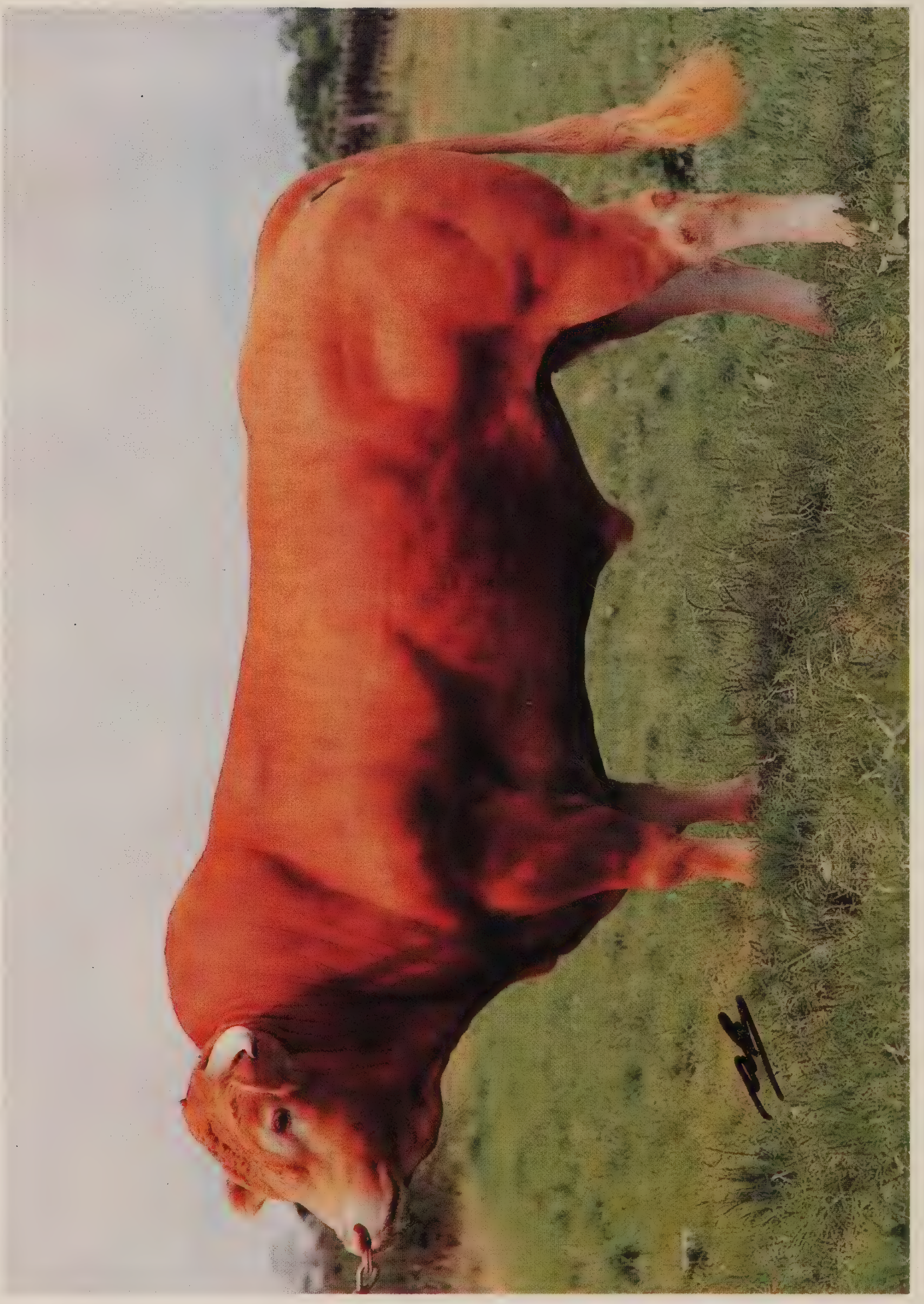

Plate 2 LIMOUSIN

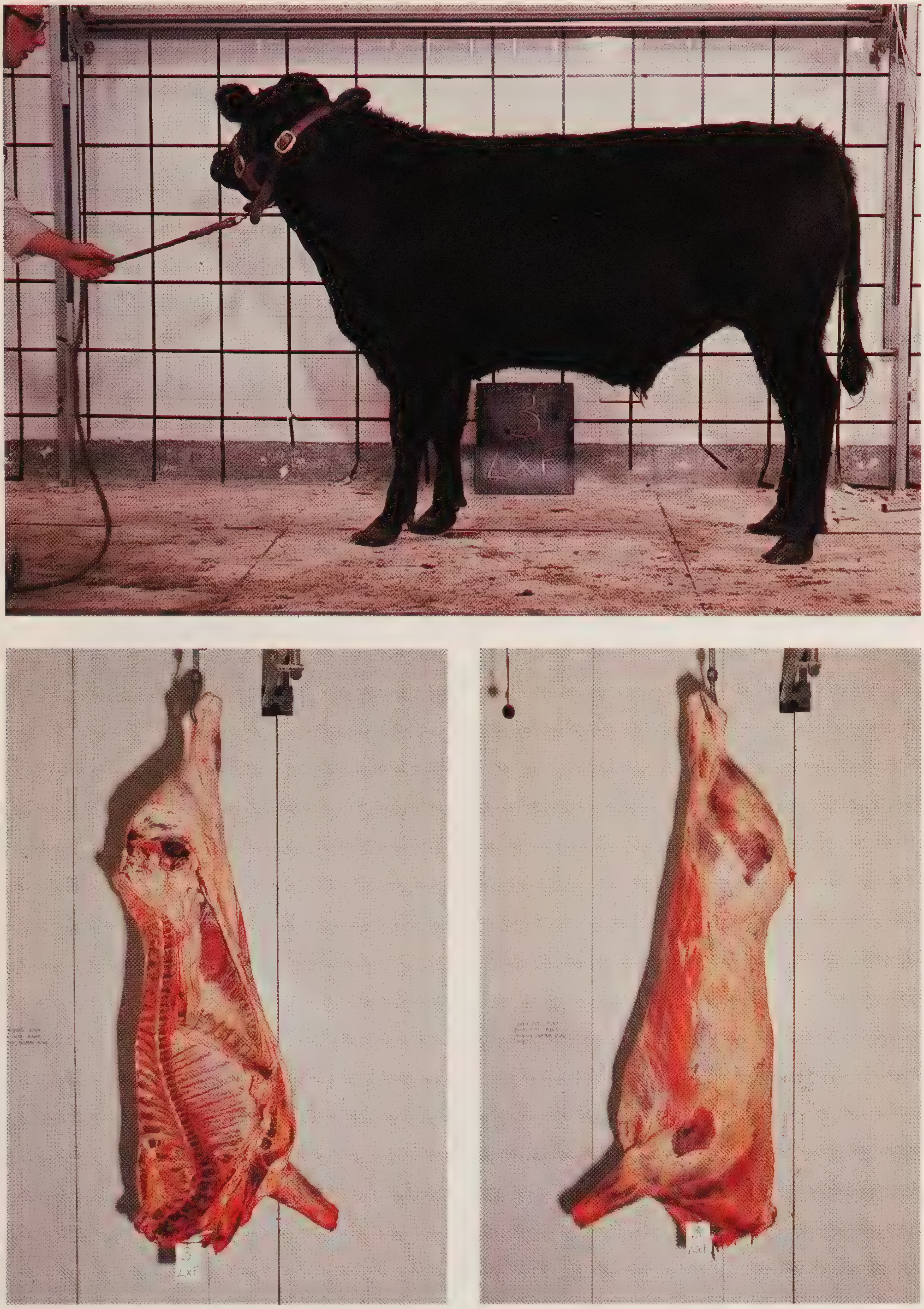

Plate 3 LIMOUSIN CROSS FRIESIAN

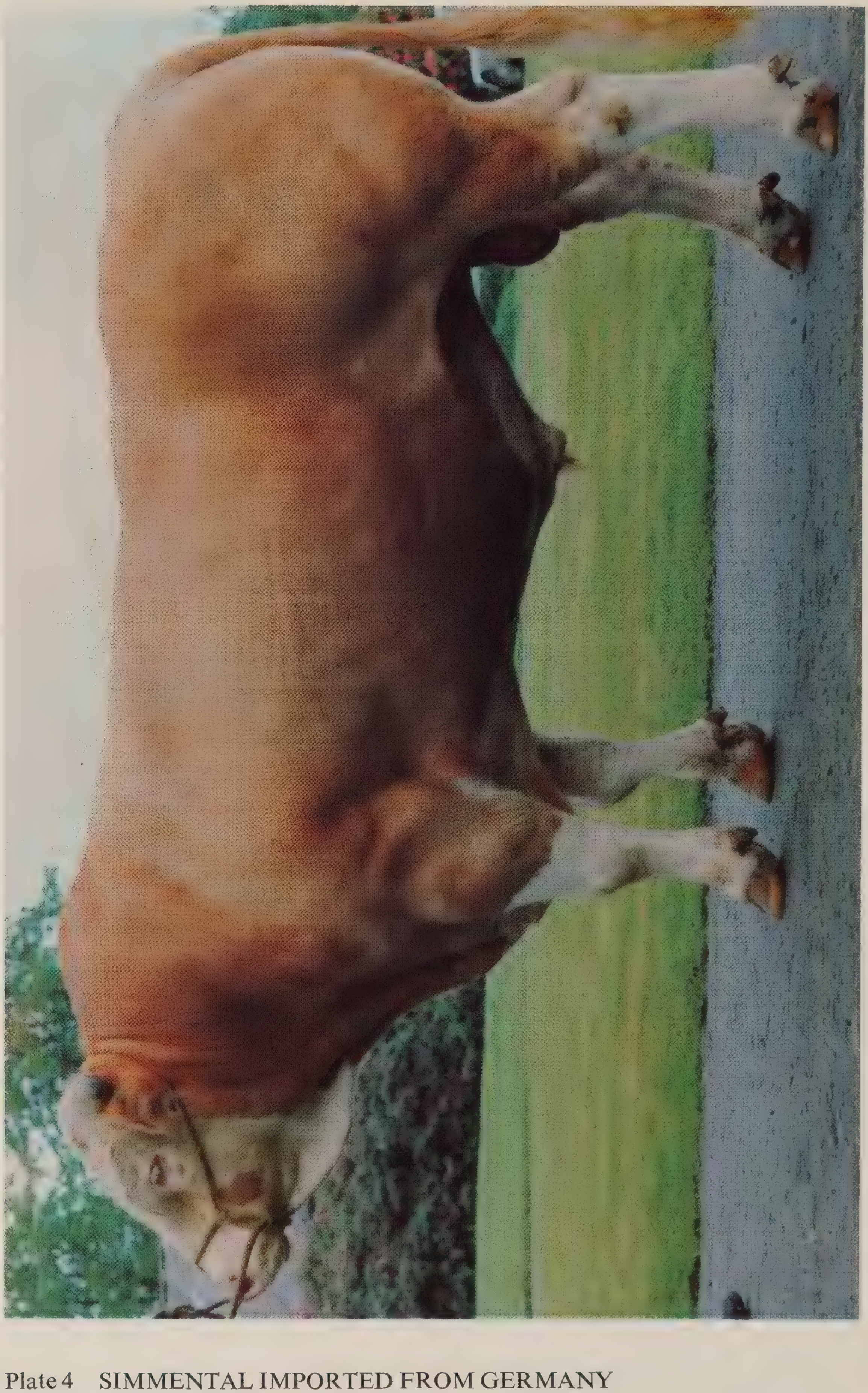

Plate 4 SIMMENTAL IMPORTED FROM GERMANY

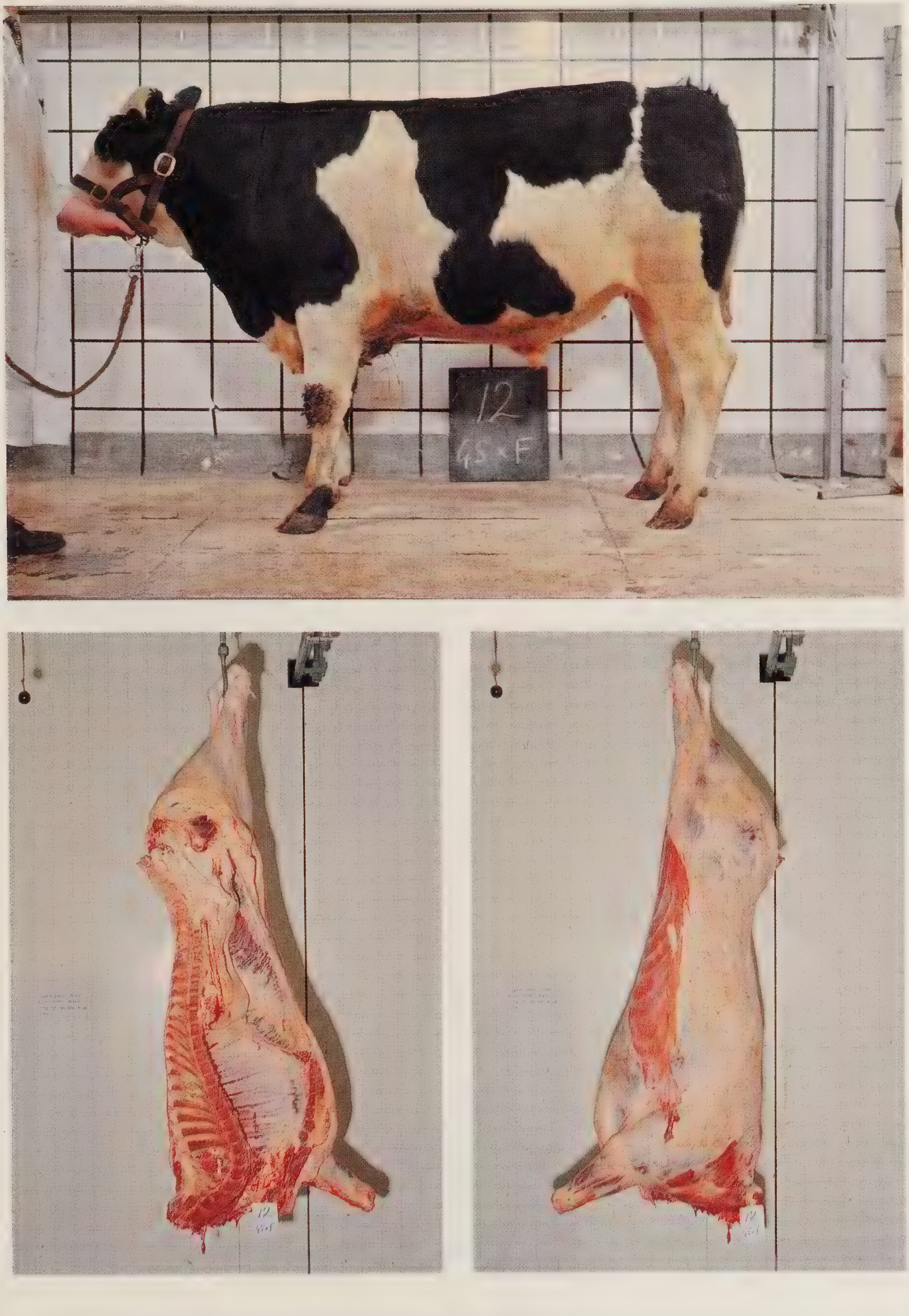

Plate 5 GERMAN SIMMENTAL CROSS FRIESIAN

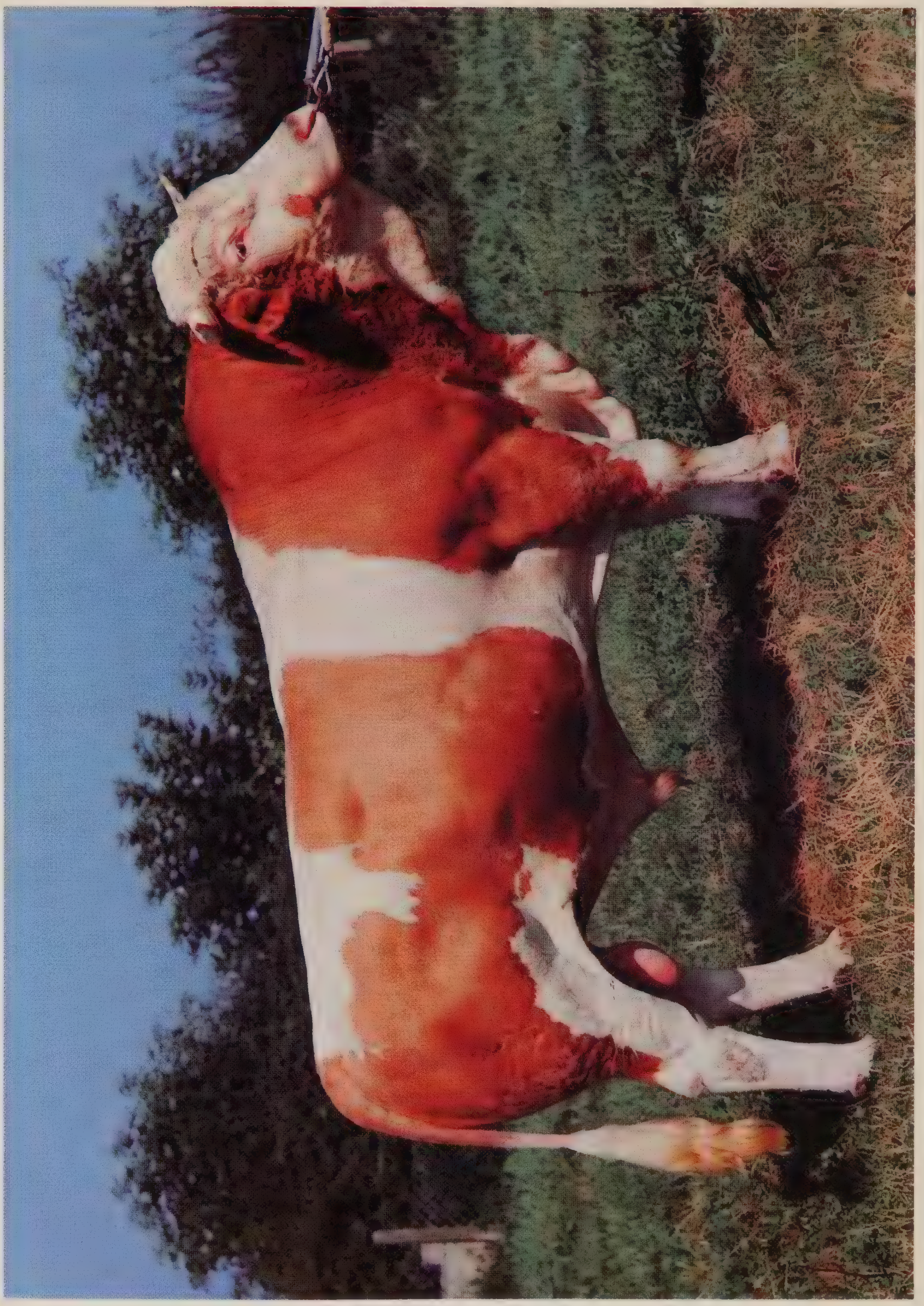

Plate 6 SIMMENTAL IMPORTED FROM SWITZERLAND

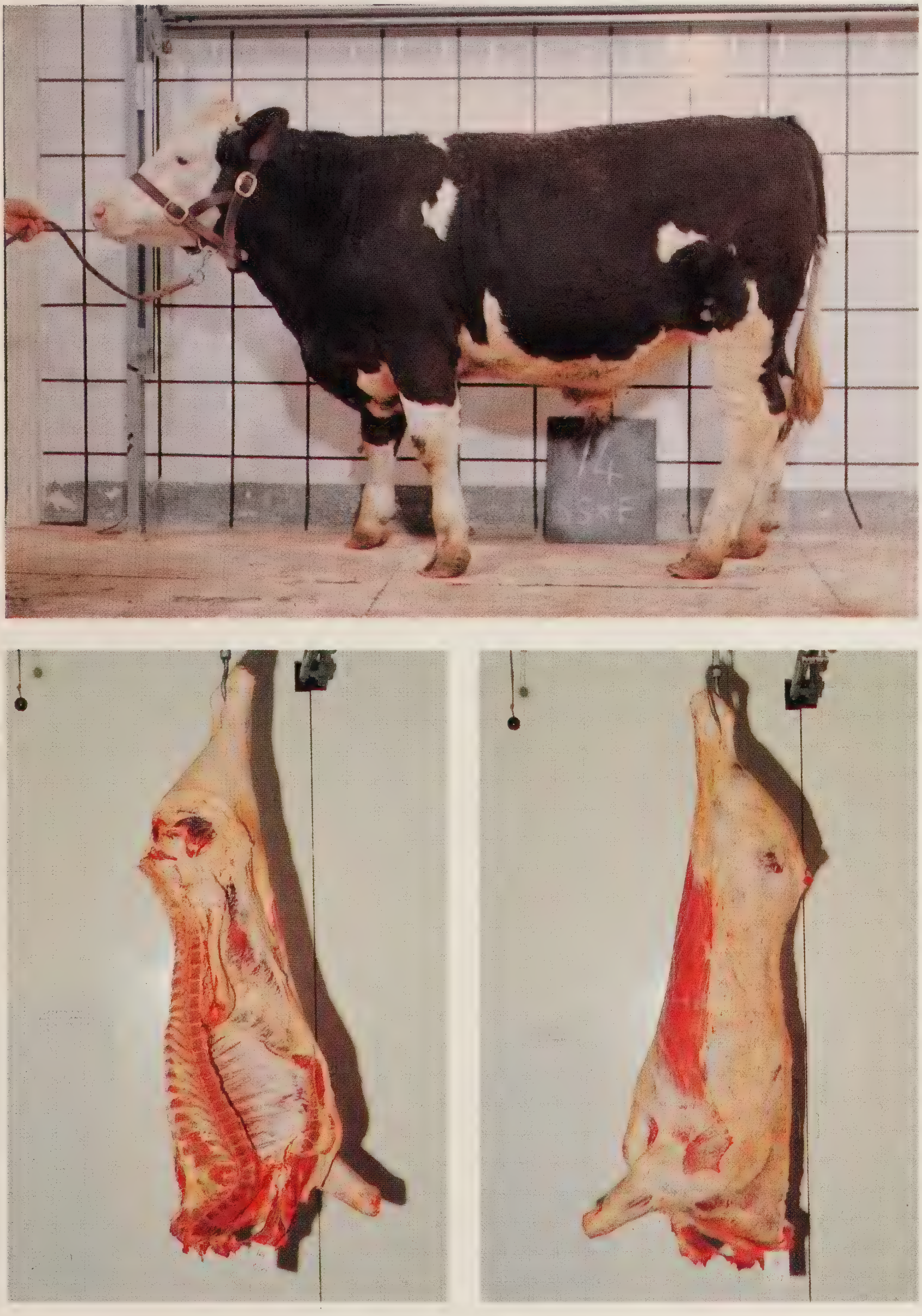

Plate 7 SWISS SIMMENTAL CROSS FRIESIAN

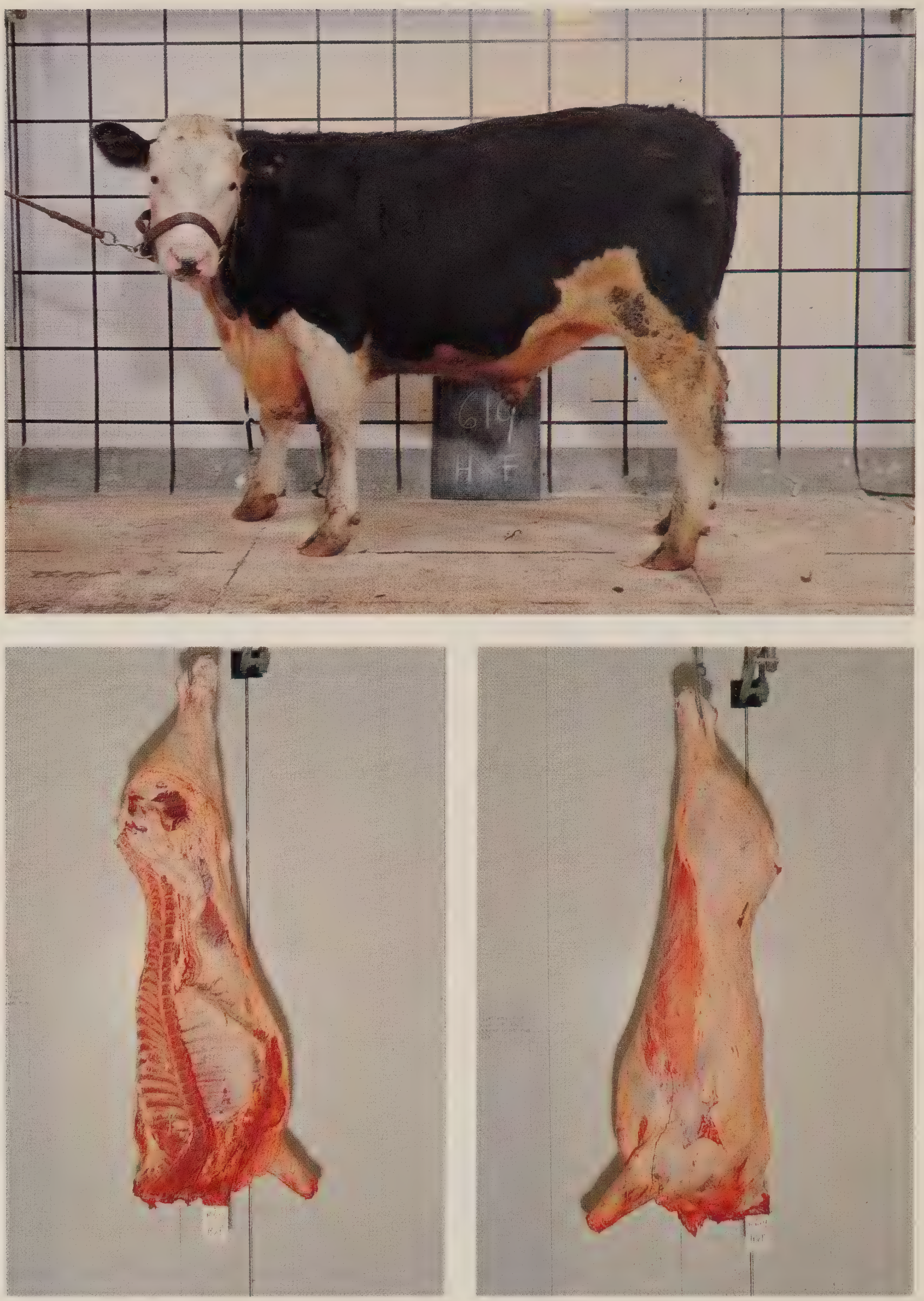

Plate 8 HEREFORD CROSS FRIESIAN

6.28 The final verdict of the industry is yet to be seen. But the recent trends of AI demand in Tables 6.5 and 6.6 appear to agree with our evaluations. The advantages of the Simmental may little more than compensate for its disadvantages. It is still possible that the carcase merit of the Limousin may result in the expansion of this breed in Britain.

Other considerations

6.29.1 An aspect to which our evaluation was not directed covers the development of export markets. We appreciate that there have been substantial exports of semen from the imported breeds included in the evaluation (and from breeds which were subsequently imported into Britain).

6.29.2 Another aspect of some relevance is the fact that the market for beef has many facets, and where there is a demand for large carcases for example, for export to western Europe, the large breeds included in our evaluation may have particular merit.

6.29.3 These assessments are based on the average results for each breed found in the evaluation. Within each breed bulls varied, sometimes significantly, in calving performance and in growth rate. As in all cattle improvement, selection within the breed could result in better or poorer results than those regarded as breed averages.

6.29.4 The earlier economic assessment relates particularly to the individual farmer. It is pertinent to consider whether the use of the large framed bulls offered by the imported breeds may lead to an increase in the national beef supply. The results from the experimental centres' trial suggest that, at a constant fat percentage in the carcase, the imported breeds produced progeny with heavier carcases (about 70 kg) than did the Herefords but at the expense of some increase in feed requirement per kg of cold carcase weight. However, if the imported breeds being considered eroded the demand for Herefords by say 100,000 inseminations (ie their share of the AI demand was trebled approximately) the effect would be to increase the supply of home produced beef by some 7,000 tonnes, or about 0.7% of the 1974 UK beef production (Craven and Kilkenny 1976).

6.29.5 Our work provided no data on the possible advantages, to the individual farmer, in fattening crossbred heifers from Friesian cows sired by bulls of these breeds compared with Hereford cross Friesian heifers for example. It would appear logical to expect some advantages but in view of the points made in 4, above, the national advantage could be very small indeed. In general, research evidence indicates the important effect of the size of the dam on the overall efficiency of a suckler cow enterprise and there would not necessarily be any overall or cumulative economic advantage from retaining the larger crossbred females as suckler cows.

Plates 1, 3, 5, 7 and 8, which follow, are representative cattle and their carcases, from the trial at Experimental Centres, to illustrate the differences in the amounts of internal and external fat amongst the breed types.

Plates 2, 4 and 6 are bulls whose progeny were included in the evaluations. (Printed with permission from the Milk Marketing Board of England and Wales and the Scottish Milk Marketing Board.)

Appendix 1

The calving surveys

Introduction

The 13 Simmental bulls, imported from Germany by the AI Organisations in Great Britain, became available for use during the last quarter of 1970, the 10 from Switzerland early in 1971 whilst the 6 Limousin sires were not available for AI use until October 1971. The results below cover all the records collected up to May 1973.

The Tests Steering Committee was concerned with breed evaluations and the AI Organisations, individually, were responsible for assessing the differences between the bulls and for taking the appropriate action on those which gave a high incidence of calving difficulty.

In England and Wales, farmers who had used the imported sires were sent a prepaid card on which was entered the name and/or number of the dam, the number of the sire and the date of insemination. They were asked to answer the questions when the cows had calved and to return the cards to the AI Organisation; all the records available by mid 1973 have been analysed. In Scotland, the Scottish Milk Marketing Board staff interviewed and completed cards for the farmers who took inseminations between specified dates. A second card was completed for those calvings indicated as 'difficult'. Each of the AI Organisations hoped to obtain records on at least 200 calvings by each bull out of Friesian and/or Ayrshire cows but this was not possible for every bull.
(The questions asked by the AI Organisations are given at the end of this appendix).

In the analysis of the cards they were first separated by breed and parity of dam (first calvers separate from second and later calvers; these are designed 'Heifers' and 'Cows' respectively in this appendix) and then by individual sire to obtain information on the particular bulls. The separation into breed of dam groups provided records for an individual sire analysis for calvings out of Friesian cows and for an appraisal of groups of bulls in respect of Friesian heifers and Ayrshire cows. The results for the various calving characteristics were then aggregated, where appropriate, and are given by breed and parity of dam.

Records from single born calves only were included in the analysis; twin and multiple births accounted for 3.2% of the total twin, multiple and usable single birth records.

Malpresentations are included in the particular calving category reported by the farmer.

In the report mortality includes calves born dead or which died within 48 hours of birth. Furthermore, mortality and serious difficulty are treated as separate characteristics although some, though by no means all, of the cases of serious difficulty resulted in dead calves while some of the deaths occurred in normal calvings.

It is regretted that contemporary data did not exist to provide a comparison of the situation when Friesian and Ayrshire cows and heifers are bred pure. Some information from Friesian bulls has now been collected by the MMB and the results, from a different survey method, are included where appropriate. (These data were summarized from answers, supplied by farmers to questions put to them when inseminators visited the farms.)

Friesians

Calf mortality—Friesian cows

Table A1.1 below compares German Simmental, Swiss Simmental and Limousin sires with bulls of the MMB E series of Charolais and MMB Team V Herefords. Both the Charolais and Herefords were progeny tested in England and Wales for calving traits at about the same time as the imported sires and the results were collected by the same survey method. The various breeds were not necessarily used on the same farms, but there is no reason to expect any bias between the samples of cows mated to the different breeds of sire.

Table A1.1 *Calf mortality* (*Friesian cows*)

Breed and number of sires		All calves		
		Total records	Number dead	% dead
German Simmental	(13)	3,187	129	4.0
Swiss Simmental	(10)	2,138	103	4.8
All Simmentals	(23)	5,325	232	4.4
Limousin	(6)	971	32	3.3
Charolais E Series	(11)	1,053	58	5.5
Hereford Team V	(27)	4,726	126	2.7

In Table A1.1 differences of less than 1.5% in mortality between breeds of bull are not statistically significant and may be ignored. The Hereford produced the lowest incidence with the Limousin not significantly higher than the Hereford. There was no difference between the Simmental breeds or between the German Simmental and Limousin but the Swiss Simmental gave significantly higher mortality than the Limousin. The Charolais gave the highest mortality. However, mortality was lower (4.7%) in the previous Charolais test (the C series bulls).

Serious difficulty (dystokia)

Table A1.2 gives the dystokia figures for the same bulls grouped in the same way as in Table A1.1. (Figures, collected by the method described earlier, for the percentage of serious difficulty from calvings to Friesian bulls are included.) The records are divided into those which did and did not require veterinary assistance.

Table A1.2 *Serious difficulty* (*Friesian cows*)
All calves

Breed and number of sires		Total records	*without vet %	øwith vet %	Total %
German Simmental	(13)	3,187	1.7	1.6	3.3
Swiss Simmental	(10)	2,138	1.8	2.0	3.7
All Simmentals	(23)	5,325	1.7	1.7	3.5
Limousin	(6)	971	1.0	1.3	2.4
Charolais E Series	(11)	1,053	1.9	3.5	5.4
Hereford Team V	(27)	4,726	0.3	0.6	0.9
Friesian	—	17,016	—	—	2.5

* = without veterinary assistance
ø = with veterinary assistance

In Table A1.2 differences in the incidence of serious difficulty of less than 1.5% between crossing breeds are not significant and may be ignored; thus the Hereford was just better than the Limousin which did not differ from either breed of Simmental. The Charolais team (Series E) produced the highest incidence of serious difficulty. An earlier tested Charolais team (Series C) yielded results similar to the Simmental.

The data suggest that in calvings from Friesian cows the Limousin breed provides no greater risk of difficult calving than the Friesian sire but more calving difficulty occurs when the Friesian is mated to German Simmental sire than in Friesian to Friesian mating.

Overall calving experience

In the survey made in England and Wales there were three categories of calving performance 'normal', 'some assistance' and 'serious difficulty'; in Scotland only two categories 'normal' and 'serious difficulty' were recorded. 'Some assistance' allowed farmers to record cases where assistance was given, whether or not this was really necessary. Discussions with veterinary surgeons and consideration of similar surveys indicate that a normal calving might be placed in the 'some assistance' group if the farmer happened to be present at the time of calving. It is possible that calvings to these new breeds would receive more than normal attention from the stockman or farmer.

The category of 'some assistance' must therefore be treated with reserve but some 18% of Limousin calvings, 24% of German Simmental calvings and 31% of Swiss Simmental calvings were recorded as having been given some assistance.

A comparison of mortality and serious difficulty in Friesian heifers and Friesian cows

It was possible to compare the incidence of mortality and seriously difficult calvings out of Friesian heifers with those out of Friesian cows. The figures are given in Table A1.3.

Table A1.3 *Mortality and serious difficulty (Friesian dams)*

		Calvings from heifers			Calvings from cows		
Breed and number or sires		Total records	% mortality	% serious difficulty	Total records	% mortality	% serious difficulty
German Simmental	(13)	218	6.4	5.5	3,187	4.0	3.3
Swiss Simmental	(10)	144	19.4	13.9	2,138	4.8	3.7
All Simmental	(23)	362	11.6	8.8	5,325	4.4	3.5
Limousin	(6)	388	10.3	8.2	971	3.3	2.4
Charolais E Series	(11)		No records		1,053	5.5	5.4
Hereford Team V	(27)	933	5.0	2.5	4,726	2.7	0.9
Friesian	—	1,595	—	5.7	17,016	—	2.5

As would be expected, the incidence of both mortality and serious difficulty was greater in heifers than in cows.

There was no significant difference between the Hereford and German Simmental in percentage mortality out of heifers. The Limousin figure was significantly higher than the figures for these two breeds whilst the Swiss Simmental was significantly higher still than the Limousin.

Considering serious difficulty in calvings to heifers, the Hereford was significantly better than the other three crossing breeds whilst the Swiss Simmental gave significantly more difficulty than the others. There was no real difference between the Limousin and the German Simmental nor between the Limousin and the average of the combined figures for the two breeds of Simmental. (The data from calvings to Friesian bulls were collected by the different survey method described earlier.)

The important conclusion to be drawn from the figures in Table A1.3 is that the German Simmental, Swiss Simmental and Limousin breeds all produce high rates of mortality and serious difficulty when used on heifers; they provide ample confirmation of the warning given at the outset by the Tests Steering Committee, the Artificial Insemination Organisations, and the Ministry of Agriculture, Fisheries and Food that bulls of large breeds should not be used on heifers.

Gestation lengths and birthweights

The survey in Scotland did not include 'some assistance' as a category of calving experience and it was necessary to consider the data collected in Scotland separately from those collected in England and Wales. Comparisons of the groups of data from heifer and cow calvings were made within each grade of calving experience and for males and females separately within the groups of bulls. For the German Simmental breed only, the results from the survey in England and Wales were then compared with those collected in Scotland.

Table A1.4 gives the average gestation lengths for normal calvings for the two parities of dam and the different groups of bulls.

Table A1.4 *Average gestation lengths (normal calvings—Friesian dams)*

Breed and number of sires		Calvings from heifers Total records	Average (days)	Calvings from cows Total records	Average (days)
German Simmental (Scotland)	(6)	20	282.3	287	284.3
German Simmental (England and Wales)	(7)	95	284.3	2,084	285.1
Swiss Simmental	(10)	68	283.9	1,391	285.7
Limousin	(6)	176	285.6	773	287.4
Charolais E Series	(11)	No records		671	284.2
Hereford Team V	(27)	641	280.7	4,170	282.0

In general, for both heifers and cows there was little difference in average gestation length between the Charolais, German Simmental and Swiss Simmental. For cows they were 2–3 days longer than the Hereford and 3–4 days longer than the average for a Friesian carrying a purebred calf (281 days). The Limousin showed the longest gestation period, some 5 days and 6 days longer than the Hereford and Friesian respectively. Male and female calves, in cows, were apparently carried significantly longer if they were by Swiss bulls rather than by German bulls in England and Wales.

With cows the results indicate that an increase in the gestation period was associated with increased difficulty at calving—see Table A1.6 page 57. As might be expected male calves, in difficult calvings, were carried slightly longer than female calves. These are, however, rather small effects in the practical situation compared with the fact that a Friesian cow in calf to one of these imported breeds is likely to have a gestation period 3–6 days longer.

The longer gestation period when these breeds are used should be borne in mind by farmers when planning steaming-up and preparations for calving.

Birthweights

Both estimated and actual birthweights were included in the analysis but only when there was an accompanying gestation length record, otherwise it would have been impossible to judge whether an abnormal high or low birthweight was due to an abnormally long or short gestation. The averages of the estimated and actual weights, in the sample collected by Associated AI Centres, did not differ significantly. Additionally some very high estimates (more than 90 kg) were excluded and some gestation records did not have accompanying birthweights. These are the reasons for the difference between total number of gestation records and birthweight records.

For the German Simmental bulls in Scotland some 62% of the total number of birthweight records from heifers were estimated; from cows the figure was 51%. In England and Wales the corresponding figures were, for German Simmental bulls 59% and 57%, for Swiss Simmental bulls 70% and 64%, and 62% and 65% for Limousin bulls. No birthweight records were collected for the Charolais E Series and Hereford Team V bulls.

Table A1.5 gives the average birthweights of all calves from normal calvings to Friesian heifers and cows. As with the gestation data comparisons were made within the different groups of bulls. In addition the German Simmental results in England and Wales were compared with those in Scotland.

Table A1.5 *Average birthweights of calves (normal calvings—Friesian dams)*

Breed and number of sires		Calves from heifers		Calves from cows	
		Total records	Average (kg)	Total records	Average (kg)
German Simmental (Scotland)	(6)	20	40.9	285	43.2
German Simmental (England and Wales)	(7)	90	41.5	2,005	43.9
Swiss Simmental	(10)	64	40.4	1,324	44.2
Limousin	(6)	168	38.0	737	41.7

There was little difference in the average birthweights of calves by the 3 groups of Simmental bulls. The Limousin bulls produced smaller calves, on average about 2 kg lighter out of cows and 3 kg lighter out of heifers.

Relationship between birthweight and difficult calvings

The data show that higher birthweights and longer gestation lengths were associated with increased difficulties at calving. Table A1.6 gives, for comparison with Tables A1.4 and A1.5, the average birthweights and gestation lengths for seriously difficult calvings for the breeds of bull on Friesian dams.

Table A1.6 *Average birthweights and gestation lengths (seriously difficult calvings—Friesian dams)*

Breed and number of sires		Calvings from heifers		Calvings from cows	
		Average birthweight (kg)	Average gestation (days)	Average birthweight (kg)	Average gestation (days)
German Simmental	(13)	45.1 (11)	287.2 (12)	51.1 (95)	288.2 (106)
Swiss Simmental	(10)	48.0 (15)	286.6 (20)	53.8 (71)	288.4 (80)
Limousin	(6)	44.9 (26)	288.3 (32)	48.2 (20)	288.5 (23)

The figures in brackets refer to the number of records in each average; the numbers of birthweight and gestation records differ for the reason given earlier in the report.

Ayrshires

There were fewer data for calvings from Ayrshire dams than for the Friesian and they did not justify an analysis by individual sires. Few records on calvings out of Ayrshire heifers were obtained. No data are available from the use of Ayrshire bulls on Ayrshire heifers or cows.

The following tables of averages are in the same format as for Friesian cows. The data on mortality and serious difficulty have been aggregated for all German Simmental (13 bulls), for Swiss Simmental (10 bulls) and for Limousin (6 bulls). There are, however, no comparative data from Charolais or Hereford sires.

Calf mortality—Ayrshire cows

Table A1.7 gives the figures for German Simmental, Swiss Simmental and Limousin bulls.

Table A1.7 *Calf mortality* (*Ayrshire cows*)

Breed and number of sires		All calves		
		Total records	Number dead	% dead
German Simmental	(13)	1,061	61	5.7
Swiss Simmental	(10)	279	17	6.1
All Simmental	(23)	1,340	78	5.8
Limousin	(6)	138	6	4.3

There were no differences between the three breeds of sire for calf mortality; in all cases the percentages were higher than when the bulls were used on Friesian cows. No ready explanation is available for this.

Serious difficulty (dystokia)

Table A1.8 gives the data on dystokia for Ayrshire cows by the three imported breeds.

The difference between the incidence of serious difficulty from the Limousin and the German Simmental was just significant but there was no real difference between Limousin and Swiss Simmental or between the two breeds of Simmental. Serious difficulty in male calves by the Swiss Simmental was noticeably lower than the German figures, but the number of records was rather small to draw any firm conclusions.

Table A1.8 *Serious difficulty at calving (Ayrshire cows)*

Breed and number of sires		All calvings Total records	*without vet %	øwith vet %	Total %
German Simmental	(13)	1,061	2.4	2.0	4.3
Swiss Simmental	(10)	279	0.7	1.8	2.5
All Simmental	(23)	1,340	2.0	1.9	4.0
Limousin	(6)	138	0	0.7	0.7

* = without veterinary assistance
ø = with veterinary assistance

Of the 93 calves, by the imported bulls, born to heifers mortality accounted for 6% and the incidence of serious difficulty was 9%. The numbers did not justify subdivision according to breed of bull.

Overall calving experience

The results from England and Wales included the category 'some assistance'. Reference has already been made to the subjective nature of this classification. However similar trends were shown to the results from Friesian cows. Some 14% of Limousin, 23% of German Simmental and 28% of Swiss Simmental calves were recorded as receiving some assistance at calving.

Gestation lengths and birthweights

The data from Scotland and from England and Wales have been considered separately for the reason given in the Friesian section of this report. Table A1.9 gives the average gestation lengths for normal calvings for the different groups of bulls.

Table A1.9 *Average gestation lengths (normal calvings—Ayrshire cows)*

Breed and number of sires		Calvings from cows Total records	Average (days)
German Simmental (Scotland)	(6)	484	285.6
German Simmental (England and Wales)	(7)	396	286.8
Swiss Simmental	(10)	193	287.1
Limousin	(6)	117	289.4

There was little difference between the three groups of Simmental although the gestation length in Scotland was somewhat shorter. This may result from the female calf gestations, in Scotland, being significantly shorter than those from the German Simmental bulls in England and Wales. The average gestation length for Simmental crosses was about 4 days longer than when an Ayrshire cow carries an Ayrshire calf (282 days).

The Limousin gestations were noticeably longer by 2–3 days compared with Simmentals and 6–7 days longer than the purebred Ayrshire gestation.

Birthweights

For the German Simmental bulls in Scotland some 51% of the total number of birthweight records from cows were estimated. In England and Wales the corresponding figures were 50%, 59% and 68% for German Simmental, Swiss Simmental and Limousin bulls respectively.

Table A1.10 gives the average birthweights of all calves from normal calvings out of cows.

Table A1.10 *Average birthweights of calves (normal calvings—Ayrshire cows)*

Breed and number of sires		All calves	
		Total records	Average (kg)
German Simmental (Scotland)	(6)	475	40.6
German Simmental (England and Wales)	(7)	356	38.7
Swiss Simmental	(10)	179	41.5
Limousin	(6)	102	38.0

On average, the Simmental calves were about 2 kg heavier than those by the Limousin bulls. The German Simmental bulls in Scotland gave heavier calves than those in England. Female calves by the Swiss bulls were heavier than those by the German bulls used in England and Wales.

Body pattern, body and head colouring

For this analysis all available completed cards for single calvings, twins etc, were aggregated regardless of age of dam. Farmers were asked:

a) Whether the calf was one colour, broken or roan.

It was intended that this question should relate to the body pattern. Animals with a white head, white socks and white switch to the tail should be counted as 'one colour'; 'broken' was to refer to definite patches of white with some other colour. No explanation of this was provided with the card and judging from farmers' comments it seems that some animals classified as 'broken colour' should have been included in the 'one colour' category. This possible misinterpretation should be remembered in considering the results.

b) Whether the calf had a white head in the case of the Simmentals. This question was, of course, not applicable to Limousin bulls.

c) What is the colour?
Farmers were asked to state the colour and a wide variety of colours and shades resulted. These were classified into 5 groups (red, brown, black, grey/blue/smokey and others including dun) for Friesian calves and 3 (red, brown and other) for Ayrshire calves. It is realised this classification is somewhat arbitrary but the figures indicate the range of colouring which may be expected.

With Friesian dams 85% of the German Simmental and 88% of the Swiss Simmental cross progeny were recorded as 'broken colour', with 51% and 53%, respectively, described as red or brown and 26% or 20% as black. 90–94%, depending on the body pattern, were reported as having white heads, a category which includes animals with 'spectacles'.

About 81% of the Limousin cross Friesian calves were described as 'one colour' and about 34% of these were brown and 48% were black.

With Ayrshire dams 84% of German Simmental and 88% of Swiss Simmental cross progeny were described as 'broken colour' and from 3.5% to 15.2%, depending on the body pattern, of all calves were other than red or brown. About 85% of the German Simmental crosses and 96% of the Swiss Simmental progeny had white heads, including animals with 'spectacles'.

Some 88% of the Limousin cross Ayrshire calves were described as 'one colour' and about 94% were, as might be expected, red or brown.

It seems clear that the Simmental breeds do not 'colour mark' their progeny as consistently as does the Hereford breed; they also produce a wider range of colours and fewer white heads. Colour inheritance in Limousin crosses is, in general, much as would be expected from the cow breeds used in the survey.

Calving surveys: The questions farmers were asked to answer.

With one exception (question 6) the questions asked by all the AI Organisations were the same:

1. Date of calving.
2. Was this the dam's first calf: Yes, No.
3. Number of calves born: Single, Twin, Multiple.
4. Whether the calf was born alive or dead: (for the survey the calf was considered dead if it was dead at birth or died within 48 hours of birth).
5. The sex of the calf.
6. Calving experience: Normal, Some Assistance, Serious Difficulty (in Scotland there was no category called 'some assistance').
7. Was veterinary assistance required: Yes, No.
8. Weight of calf within 48 hours of birth. Was the weight estimated or actual.
9. Colouring pattern of the calf's body: One colour, Broken colour, Roan.
10. Actual colour of the calf:
11. Did the calf have a white head: Yes, No (not for Limousin bulls).

Appendix 2

The comparison of Friesian, German Simmental cross Friesian, Swiss Simmental cross Friesian and Limousin cross Friesian cattle in intensive cereal beef production.

Introduction

Simmental and Limousin bulls became available at different times and it was necessary to carry out the trials during two succeeding years. Details are given in Table A2.1:

Table A2.1 *Numbers of animals and farms*

	Friesian (F)	German Simmental cross (GS×)	Swiss Simmental cross (SS×)	Limousin cross (L×)	Number of recorded farms
Winter 1971/72	128	146	—	—	12
Winter 1972/73	165	—	95	48	11

The German Simmental crosses (GS×) were the progeny of 4 bulls, the Swiss Simmental cross animals (SS×) of 6 bulls and the Limousin cross cattle (L×) of 6 bulls. All bulls were owned by the Milk Marketing Board of England and Wales.

Design of the Trials

MLC staff purchased the imported breed cross bull calves, varying from 7–14 days for German Simmental crosses and 4–27 days of age for the Swiss Simmental and Limousin crosses, during the winters of 1971/72 and 1972/73. They were transported on the day of purchase to recorded cereal beef units. The German Simmental crosses were distributed on 12 farms so that each farm received the progeny of at least 3 bulls. Only six of 11 farms included both Swiss Simmental and Limousin crosses. Calves were distributed so that each breed was represented by the progeny of at least 2 bulls on each farm.

At the time of delivery, or within a few days, each producer purchased a similar number of Friesian bull calves of approximately the same age as the imported breed crosses.

The imported breed crosses were reared alongside the Friesians by the normal method of intensive cereal production practised on the farms. Apart from one farm which kept German Simmental cross cattle and contemporaries entire, all the calves were reared as steers. Liveweights were recorded at about 100 days of age and within a few days of slaughter. The decision to slaughter the cattle rested with the producer in his assessment of when they were finished.

Carcase weights were recorded for a large proportion of the animals and the carcases of most of these were scored by MLC staff for external fat cover and conformation; they also estimated the weight of the kidney knob and channel fat (KKCF); the numbers examined are given in Table A2.3. The left sides of 15 Friesian and 20 German Simmental cross animals were evaluated in detail involving cutting into standardized wholesale joints followed by separation of these into fat, lean and bone but detailed separation of a sample of Swiss Simmental cross and Limousin cross cattle could not be arranged.

Results

The production results are summarized in Table A2.2. At the end of the

Table A2.2 *Production results in intensive cereal beef production*

								Differences as % above (+) or below (−) F		
	F	GS×	sd††	F	SS×	L×	sd††	GS×	SS×	L ×
Number of animals	128	146	—	165	95	48	—	—	—	—
Weight of reared calves (kg)	119.5	118.8	—	137.3	133.6	127.7	—	−0.6	−2.7	−7.0
Length of finishing period (days)	257.0	243.3	—	232.3	230.3	243.0	—	−5.3	−0.9	+4.6
Slaughter weight (kg)	397.1	404.1	—	398.2	397.4	399.7	—	+1.8	−0.2	+0.4
Daily gain during finishing period (kg)	1.11	1.20	0.22	1.13	1.15	1.12	0.30	+8.1	+1.8	−0.9

††sd = standard deviations within farm and breed

rearing period the Friesians were 0.7 kg heavier than German Simmental crosses, 3.7 kg heavier than Swiss Simmental crosses and 9.6 kg heavier than Limousin crosses; the three crosses therefore grew slightly slower than Friesian contemporaries. However, from this stage to slaughter the German Simmental crosses had an advantage in daily gain of 0.09 kg per head whilst the daily gains for the Swiss Simmental and Limousin crosses and their contemporaries were similar. German Simmental crosses were slaughtered about 14 days earlier and 7 kg heavier than their Friesian contemporaries. The Swiss Simmental crosses, Limousin crosses and Friesians were slaughtered at similar weights though the Limousin cross cattle took 11 days longer than Friesians and 13 days longer than Swiss Simmental cross animals to get there.

Table A2.3 *Carcase results in intensive cereal beef production*

								Differences as % above (+) or below (−) F		
	F	GS×	sd††	F	SS×	L×	sd††	GS×	SS×	L×
Number of animals	104	106	—	108	79	40	—	—	—	—
Killing out percentage	55.2	55.9	1.9	56.4	56.8	58.2	—	+1.3	+0.7	+3.2
Carcase weight (kg)	221.3	225.2	—	224.7	225.6	232.6	—	+1.8	+0.4	+3.5
Carcase weight per day of age (kg)	0.62	0.65	0.13	0.63	0.62	0.62	0.15	+4.8	−1.6	−1.6
Number of animals	83	102	—	75	58	40	—	—	—	—
Fat class (external fat score) ø	2.9	2.7	0.7	2.3	2.2	2.0	0.55	−6.9	−4.3	−13.0
Conformation score øø	3.9	4.7	0.8	3.2	3.8	3.9	0.66	+20.5	+18.8	+21.9
Estimated weight of kidney knob and channel fat (KKCF) (kg)	7.7	7.35	2.2	6.5	6.4	6.6	2.19	−4.5	−1.5	+1.5

††sd = standard deviations within farm and breed

ø fat score on seven point scale from 1 leanest to 7 fattest for GS× and F
fat score on five point scale from 1 leanest to 5 fattest for F, SS× and L×

øø conformation score on seven point scale from 1 worst to 7 best shape for GS× and F
conformation score on five point scale from 1 worst to 5 best shape for F, SS× and L×

The carcase results are given in Table A2.3.

German Simmental crosses killed out 0.7% higher than Friesians and their carcases were 3.9 kg heavier. Swiss Simmental cross cattle were similar to their Friesian contemporaries whilst the Limousin crosses killed out 1.8% higher and their carcases were 7.9 kg heavier. However the carcase gains per day of age of the imported breed crosses and their respective contemporary Friesians were similar as also were the estimated weights of kidney knob and channel fat. Judged on a seven point scale the German Simmental crosses had less external fat (0.2 points) but better conformation (0.8 points) than Friesians. The Limousin and Swiss Simmental cross carcases were judged on a 5 point scale for both external fat and carcase conformation. Limousin cross animals were leanest, scoring 0.3 points less for fat class, compared with the Swiss Simmental crosses and the Friesians. For conformation the Limousin and Swiss Simmental cross carcases scored 0.6 and 0.7 points, respectively, higher than the Friesian contemporaries.

Detailed evaluation was carried out on the left sides of 20 German Simmental cross and 15 contemporary Friesian carcases; the results are given in Table A2.4. The former carcases were somewhat leaner and more thickly fleshed than the Friesian carcases. However there was no difference in the proportion of high priced cuts.

Table A2.4 *Carcase characteristics in intensive cereal beef production (as % of carcase excluding* KKCF)

				Difference as % above (+) or below (−) F
	F	GS×	sd††	GS×
Number of animals	15	20	—	—
External fat (%)	8.2	6.9	1.16	−15.9
Total fat (%)	21.0	19.7	2.62	−6.2
Lean (%)	60.9	62.5	2.46	+2.6
Bone (%)	15.3	15.1	0.81	−1.3
High priced cuts (%)	43.9	44.1	0.76	+0.5
Eye muscle area (sq cm)	56.7	62.9	4.88	+10.9

sd†† = standard deviations within farm and breed

Conclusions

Friesians grew slightly faster than Swiss Simmental cross and Limousin cross contemporaries in the rearing period; their growth rates were similar thereafter. However, although the German Simmental cross cattle grew slightly slower during the rearing period they grew faster during the finishing period than did the Friesians with which they were compared and their weights at slaughter were also greater. Whilst the German Simmental and Swiss Simmental crosses were slaughtered about 14 days and 2 days earlier, respectively, than their Friesian contemporaries the Limousin cross cattle were 11 days later than Friesians and 13 days later than the Swiss Simmental crosses. The killing out percentage of Limousin cross animals was considerably higher than the Friesians and the Swiss Simmental crosses whilst the German Simmental cross cattle were also superior to Friesians. The fat classes at slaughter and body conformation scores favoured the imported breed crosses over the pure Friesians. As the fat classes of the crosses were well within the range of commercial acceptability, the cattle in these trials could have been carried to higher weights at slaughter without them becoming overfat for the current market demands.

Appendix 3

The comparison of German Simmental, Swiss Simmental and Limousin crosses with pure Friesian and Friesian cross cattle in semi-intensive beef production

Introduction

The trials were carried out on commercial farms in England and Scotland and at the three Agricultural Colleges in Scotland. The calves were purchased for the Scottish Trials in the autumn of 1971 and for those in England in the autumn and winter of 1972. The details are given in Table A3.1.

Table A3.1 *The number of cattle and farms in the semi-intensive beef production trials*

	Friesian	Friesian cross Ayrshire	German Simmental cross Friesian	German Simmental cross Ayrshire	Swiss Simmental cross Ayrshire	Limousin cross Friesian	Number of farms
Scottish commercial farms	75	—	110	—	—	—	6ø
Scottish Agricultural Colleges	—	76	—	87	—	—	3
English commercial farms	518	—	210	—	200	85	38

ø One farm had 2 groups and another had 3 groups according to dates of birth.

The German Simmental cross Friesian (GS×) and German Simmental cross Ayrshire (GS×A) cattle in the Scottish trials were the progeny of 6 bulls owned by the Scottish Milk Marketing Board. The Friesian cross Ayrshire (F×A) animals in the College trials were sired by 7 of the Scottish Milk Marketing Board's British Friesian Bulls. In the English trials the German Simmental cross Friesian (GS×), the Swiss Simmental cross Friesian (SS×) and the Limousin cross Friesian (L×) cattle were by bulls owned by the Artificial Insemination Organisations in England.

Design of trials

MLC purchased imported breed crosses between 4 and 35 days old and delivered them on the day they were bought to recorded farms. The Colleges purchased their own calves ranging in age between 20 and 28 days old. Steer calves only were used in the trials. At the time of delivery of the imported breed crosses, or within a few days, each commercial producer purchased Friesian bull calves of a similar age to those delivered to his farm and the Colleges purchased Friesian cross Ayrshire contemporaries.

Each commercial farm, in Scotland, received progeny of at least 5 of the German Simmental bulls whilst in each College unit progeny from at least 5 German Simmental and 6 of the British Friesian bulls were included.

In all units the cattle were managed together. The calves were reared indoors until the spring; grazed through the summer and were yarded in the following autumn. On 5 of the Scottish commercial farms and at the Colleges the cattle were slaughtered out of yards during the winter and spring of 1973 whilst at the other farm the cattle were turned out to grass and finished off grass early in that summer. As the trials in England began a year later than those in Scotland the cattle were slaughtered out of yards during the winter and spring of 1974.

At the Colleges, weights and ages were recorded at delivery, turnout to grass, at yarding and within a few days of slaughter. One man selected all the cattle in the College units for slaughter. On the commercial farms in England and Scotland the cattle were weighed at turnout to grass, at yarding in the autumn and just prior to slaughter. The farmers decided when their cattle were finished.

Carcase weights were recorded on 319 Friesian, 76 Friesian cross Ayrshire, 198 German Simmental cross Friesian, 87 German Simmental cross Ayrshire, 83 Swiss Simmental cross Friesian and 30 Limousin cross Friesian animals. Most of these were scored by MLC staff for external fat cover and body conformation and the weights of kidney knob and channel fat (KKCF) were estimated. In addition the left sides of the carcases of 14 Friesian, 25 Friesian cross Ayrshire, 35 German Simmental cross Friesian, 24 German Simmental cross Ayrshire, 13 Swiss Simmental cross Friesian and 11 Limousin cross Friesian cattle were evaluated in detail by cutting into standardized wholesale joints followed by separation into lean, fat and bone. The numbers in each trial are given in the tables.

Results

The production results are summarised in Table A3.2. On commercial farms, in both England and Scotland, the German Simmental crosses were slightly heavier at turnout to grass than Friesians but the German Simmental cross and the Friesian cross animals were similar on the College farms.

In all cases the German Simmental cross cattle grew slightly faster at grass and were heavier at yarding. In the Scottish trials the German Simmental cross Friesian and German Simmental cross Ayrshire animals grew significantly faster from yarding to slaughter than their contemporaries and were heavier at slaughter but of similar ages. Both the ages and slaughter weights of the German Simmental crosses and Friesians in England were similar. Swiss Simmental sired calves were slightly lighter at turnout and yarding than the Friesian cattle, had similar daily gains but lower slaughter weights. Limousin cross calves were considerably lighter at turnout, yarding and slaughter, grew more slowly than Friesian contemporaries at grass but had similar growth rates during the finishing period. Swiss Simmental and Limousin cross cattle and the Friesians were slaughtered at similar ages.

Carcase results are given in Table A3.3.

German Simmental cross Friesian and German Simmental cross Ayrshire animals, in Scotland, killed out significantly better than the Friesian and Friesian cross Ayrshire contemporaries. External fatness scores were similar but the imported breed crosses received higher conformation scores than contemporaries, significantly higher in the case of the German Simmental cross Ayrshire cattle. German Simmental cross Friesian animals had slightly heavier weights of kidney knob and channel fat than contemporary Friesians.

In England, Limousin cross animals were slaughtered at a slightly higher level of external fatness than Friesians whereas both the Simmental crosses had slightly less than their Friesian contemporaries suggesting that they could have been taken to higher weights at slaughter. Carcase weights for both Simmental crosses and the Friesians were similar although the German Simmental crosses had slightly heavier carcases than Swiss Simmental crosses reflecting the difference in slaughter weight and killing out percentage. Though the Friesian cattle were heavier at slaughter they killed out less well to give lighter carcase weights than German Simmental crosses whilst Limousin cross carcases were slightly lighter than those of their contemporaries. The carcases of the Limousin cross animals were of better conformation than those of both Simmental crosses; these, in turn were superior to Friesian carcases. The estimated weight of kidney knob and channel fat from the Limousin crosses was less than from the other cattle breeds.

Carcase separation results are summarised in Table A3.4.

The 17 German Simmental cross Friesian carcases evaluated in detail from cattle in the Scottish commercial farms trial had 2.5% more lean and 2.3% less fat than the Friesian carcases. They also had a slightly higher proportion of high priced cuts and were slightly more thickly fleshed with an eye muscle 7 sq cm greater. Carcases from the Colleges' German Simmental

Table A3.2 *Production results in semi-intensive beef production*

	Scotland				England					Differences as % above (+) or below (−) F or F×A				
	Farms		Colleges							Scotland		England		
	F	GS×	F×A	GS×A	F	GS×	SS×	L×	F	GS× -F	GS×A -F×A	GS× -F	SS× -F	L× -F
Number of animals	75	110	76	87	222	115	132	51	110	—	—	—	—	—
Weight at (kg)														
Start	nr	nr	41	44	nr	nr	nr	nr	nr	—	+5.5	—	—	—
Turnout	206	211	201	199	184	185	178	163	186	+2.4	−0.9	+0.5	−3.3	−12.4
Yarding	322	334	323	337	317	324	315	289	323	+3.8	+4.4	+2.2	−0.6	−10.5
Slaughter	508	535	520	547	471	469	462	442	470	+5.4	−5.2	−0.4	−1.9	−6.0
Daily Gain (kg)														
Start to turnout	nr	nr	0.76	0.74	nr	nr	nr	nr	nr	—	−3.0	—	—	—
Turnout to yarding	0.69	0.74	0.75	0.84	0.69	0.71	0.70	0.66	0.71	+7.2	+12.1	+2.9	+1.4	−7.0
Yarding to slaughter	0.88	1.03	0.75	0.81	0.78	0.83	0.81	0.82	0.80	+17.1	+8.5	+6.4	+3.8	+2.5
Start to slaughter	†0.79	†0.87	0.75	0.80	0.73	0.74	0.71	0.69	0.73	+10.3	+6.3	+1.4	−2.7	−5.5
Length of finishing period (days)	196	188	nr	nr	190	181	192	199	196	−4.1	—	−4.7	−1.1	+1.5
Age at slaughter (days)	610	605	644	642	579	574	584	577	581	+0.9	+0.3	−0.9	+0.9	−0.7

†daily gain turnout to slaughter nr = not recorded

The pooled 'within farm and breed' standard deviations for daily gain from start to slaughter were 0.13 for the Scottish farm and 0.17 for the English farm trials.

Table A3.3 *Carcase results in semi-intensive beef production*

	Scotland				England					Differences as % above (+) or below (−) F or F×A				
	Farms		Colleges							Scotland		England		
	F	GS×	F×A	GS×A	F	GS×	SS×	L×	F	GS× –F	GS×A –F×A	GS× –F	SS× –F	L× –F
Number of animals	49	87	76	87	172	111	83	30	98	—	—	—	—	—
Carcase weight (kg)ø	279	313	294	310	244	246	237	232	241	+12.2	+5.4	+0.8	−2.9	−3.7
Killing out % ø	54.9	55.2	56.5	56.6	53.2	52.6	53.0	54.5	54.7	+0.5	+0.2	−1.1	−0.4	−0.3
Carcase weight/day of age (kg)ø	0.46	0.51	0.46	0.49	0.43	0.44	0.42	0.40	0.41	+10.9	+5.9	+2.3	−2.3	−2.5
Number of animals	25	45	76	87	115	87	61	23	58	—	—	—	—	—
Estimated weight of KKCF (kg)	6.1	6.3	nr	nr	8.1	7.7	8.3	5.2	7.3	+3.3	—	−4.9	+2.5	−28.8
External fat score †	2.4	2.4	2.7	2.5	2.5	2.3	2.3	2.6	2.5	0.0	−7.4	−8.0	−8.0	+4.0
Conformation score ††	2.8	3.1	2.4	2.8	2.8	3.4	3.3	3.7	2.7	+10.7	+16.7	+21.4	+17.9	+37.0

ø excluding KKCF   † scored 1 (leanest) to 5 (fattest)   †† scored 1 (leanest) to 7 (fattest)   nr = not recorded

The pooled 'within farm and breed' standard deviations were:

	Scottish farms	Scottish Colleges	English farms
Carcase weight/day of age	0.08	—	0.04
External fat scores	0.5	0.5	0.5
Conformation scores	0.5	0.59	0.59
Estimated weight of KKCF	—	2.86	2.9

Table A3.4 *Carcase separation results in semi-intensive beef production*

		Scotland				England				Differences as % above (+) or below (−) F or F×A				
		Farms	Colleges							Scotland		England		
		F	GS×	F×A	GS×A	F	GS×	SS×	L×	GS× –F	GS×A –F×A	GS× –F	SS× –F	L× –F
Number of animals		11	17	25	24	3	18	13	11	—	—	—	—	—
Side weight	(kg)	nr	nr	nr	nr	124	113	114	117	—	—	−8.9	−8.1	−5.6
External fat	(%)	7.4	6.5	8.3	7.2	nr	nr	nr	nr	−12.2	−13.3	—	—	—
Fat	(%)	21.6	19.3	24.6	22.4	18.2	15.6	15.9	16.3	−10.6	−8.9	−14.3	−12.6	−10.4
Lean	(%)	61.5	64.0	59.1	61.4	63.0	66.6	65.7	66.6	+4.1	+3.9	+5.7	+4.3	+5.7
Bone	(%)	15.3	14.9	14.7	14.5	17.4	16.5	17.0	15.6	−2.6	−1.4	−5.2	−2.3	−10.3
High priced cuts	(%)	42.7	43.4	42.7	43.3	45.2	46.7	46.1	46.2	+1.6	+1.4	+3.3	+2.0	+2.2
Eye muscle area (sq cm)		71	78	63	68	60.0	63.7	62.6	65.9	+9.9	+7.9	+6.2	+4.3	+9.8

Kidney knob and channel fat excluded in calculating percentages   nr = not recorded

The pooled 'within farm and breed' standard deviations were:

	Scottish farms	English farms
Lean %	2.4	1.3
Fat %	2.6	1.4
Bone %	0.6	0.8
Eye muscle area	8.0	6.1
High priced cuts %	1.1	0.6
% external fat	1.3	nr

cross Ayrshire cattle had 1.1% less external fat and 2.2% less total fat than the Friesian cross Ayrshire carcases. They contained 2.3% more lean and a similar percentage of bone. A slightly higher proportion of the German Simmental cross Ayrshire carcase was included in the high priced cuts and the average muscle area of these carcases was greater than from the Friesian cross Ayrshires.

In the English trials only three carcases from Friesian cattle were evaluated in detail along with a larger but nevertheless still small sample of German Simmental, Swiss Simmental and Limousin cross Friesian carcases. None of the breeds were significantly different for total fat percentage and eye muscle area. Friesian contemporaries had significantly lower percentage high priced cuts and percentage lean than imported breed crosses. Limousin crosses had the lowest percentage bone with Friesians the highest.

Conclusions

The Simmental crosses in all trials grew slightly faster than native contemporaries during the grazing season and also from yarding to slaughter to reach rather similar slaughter weights in England but they were somewhat heavier in the Scottish comparisons. The Simmental crosses and their contemporaries were similar in age at slaughter. In general Simmental cross carcases were of better conformation than the Friesians and had lower subcutaneous fat levels which suggests they could have been taken to heavier weights without becoming over fat.

Cutting tests indicated a higher lean content, a slightly higher proportion of high priced cuts and a greater eye muscle area, indicating somewhat thicker fleshing.

Limousin crosses grew more slowly than Friesian contemporaries during the grazing season, but had similar growth rates during the finishing period. They were slaughtered at lighter weights but had a markedly higher average conformation score than Friesian cattle and could attract better carcase prices.

Appendix 4

The evaluation of the Limousin and Simmental breeds as sires of suckled calves

Limousin and Simmental cross calves were weighed in 344 MLC recorded suckler herds where they were reared alongside contemporary calves sired by Aberdeen Angus, Charolais, Devon, Hereford, Lincoln Red and South Devon bulls. The numbers of weighings of calves by each sire breed within two days of birth and within 49 days of 200 and 300 days of age, respectively, are given in Table A4.3 at the end of this appendix.

Birthweights and adjusted 200 and 300 days weights for each of the sire breeds are presented for lowland, upland and hill herds in Table A4.1.

Table A4.1 *Weight-for-age of crossbred suckled calves in recorded lowland, upland and hill suckler herds (kg)*

Age:	Birth			200 days			300 days		
Herd location	Lowland	Upland	Hill	Lowland	Upland	Hill	Lowland	Upland	Hill
Sire breed									
Charolais	45.8	42.6	39.5	240.4	227.2	205.0	310.7	293.9	278.1
South Devon	44.9	41.3	38.6	231.3	220.9	119.6	299.4	287.1	267.6
SIMMENTAL	45.4	41.3	38.6	232.2	222.3	197.8	302.5	288.5	268.1
Devon	40.8	39.5	36.3	225.4	215.0	191.0	286.7	283.9	259.0
Lincoln Red	40.4	38.6	36.3	222.3	214.1	188.7	285.8	280.3	260.4
LIMOUSIN	39.5	39.0	—ø	215.0	203.7	186.4	293.0	283.5	262.6
Hereford	36.7	35.8	31.8	208.2	194.1	184.2	278.1	267.2	254.0
Aberdeen Angus	32.7	30.8	28.6	194.1	182.3	176.0	268.1	252.7	240.9

ø Insufficient results for analysis

The results for the established breeds confirm previous MLC findings. The Charolais sired calves had the heaviest weights at each stage followed by the South Devon, Devon, Lincoln Red, Hereford and Aberdeen Angus. The calves sired by Simmental bulls were lighter than Charolais crosses, but similar in weight to South Devon crosses at birth, 200 and 300 days. Limousin crosses were similar in weight to Lincoln Red crosses at birth, intermediate in weight between Lincoln Red and Hereford crosses at 200 days and slightly heavier than Lincoln Red crosses at 300 days. These patterns of performance were repeated in the three herd locations, but with a progressive decline in weight-for-age from the lowland to the hill environment.

When calf weights are analysed by sire breed and herd location there is a possibility of bias in the results caused by individual herd effects. This problem is overcome by contemporary comparison analysis which compares calves sired by each breed with Hereford cross calves in the same herd, under the same management, born in the same season, out of the same breed type of cow and of the same sex.

The results presented in Table A4.2 confirm that Simmental crosses had almost identical performance to South Devon crosses and Limousin crosses performed at a similar level to Lincoln Red crosses. The results illustrate well how weight superiority accumulates as the calves increase in age.

Table A4.2 *Contemporary comparison of calf weights in recorded lowland, upland and hill herds (kg)*

Age: Sire breed	Birth	200 days kg above (+) or below (−) Hereford crosses	300 days
Charolais	+5.9	+15.4	+21.8
South Devon	+5.4	+11.8	+18.1
SIMMENTAL	+5.0	+12.7	+18.1
Devon	+3.2	+9.1	+13.2
Lincoln Red	+3.2	+8.2	+12.7
LIMOUSIN	—ø	+7.7	+15.0
Hereford	0.0	0.0	0.0
Aberdeen Angus	−3.6	−14.1	−19.1

ø Insufficient results for analysis

Summary

Birth weights and calf weights adjusted to 200 and 300 days were recorded in 344 suckler herds rearing calves by Limousin and/or Simmental bulls and by other sire breeds.

Sire breeds were compared by average calf weight in lowland, upland and hill herds and by contemporary comparison with Hereford cross calves. Calves sired by Charolais, South Devon, Devon, Lincoln Red, Hereford and Aberdeen Angus bulls were included in this analysis.

Simmental cross calves had similar weights to South Devon crosses at birth, 200 and 300 days. They were consistently lighter than Charolais cross calves and heavier than the other breeds recorded.

Limousin cross calves had similar weights to Lincoln Red cross calves at birth, 200 and 300 days of age.

The ranking of the different sire breeds was similar in the three farm types and was in agreement with previous MLC recorded data.

Table A4.3 *Number of weighings in recorded suckler herds January 1972 to August 1974*

Sire breed	Birth	200 ± 49 days	300 ± 49 days
Charolais	1,316	2,874	2,006
South Devon	226	597	409
SIMMENTAL	605	1,636	1,271
Devon	208	408	338
Lincoln Red	241	514	385
LIMOUSIN	187	528	306
Hereford	2,005	4,724	3,129
Aberdeen Angus	916	2,247	2,006
Totals	5,704	13,528	10,158

Appendix 5

The food conversion efficiency and carcase quality of steers by Friesian, Hereford, Limousin, German Simmental and Swiss Simmental bulls out of Friesian cows

Introduction

Four ADAS Experimental Husbandry Farms, Boxworth, Drayton, High Mowthorpe and Liscombe and the Norfolk Agricultural Station allocated the whole of their individual feeding facilities for one complete crop of animals to contribute to the Breed Evaluations co-ordinated by the Limousin and Simmental Tests Steering Committee.

The cattle

In the autumn of 1972, with the help of the Meat and Livestock Commission, 30 male calves each by Limousin, German Simmental and Swiss Simmental bulls standing at Artificial Insemination Centres in England and Wales, were purchased at approximately 10 days of age and located at four of the experimental centres; one centre reared the calves to 12 weeks for the fifth centre in addition to its own. The calves were the progeny of 5 Limousin, 7 German Simmental and 11 Swiss Simmental bulls owned by Avoncroft Cattle Breeders Ltd, Cambridge and District Cattle Breeders Ltd, Cattle Breed Improvement Services Ltd, Hampshire Cattle Breeders Society Ltd and the Milk Marketing Board. An attempt was made to distribute the progeny of each bull uniformly over all centres. This was achieved to a large measure with Limousin and to a lesser extent with Simmental bulls.

At the same time the centres obtained similarly aged Friesian and Hereford cross Friesian male calves, as contemporaries; these were purchased from their normal sources of supply and it is possible that the samples of these breeds differed genetically between centres. The distribution of calves over the five centres is given below. It was not possible to have progeny of all sires at all centres.

Table A5.1 shows the distribution of cattle and the methods of housing and feeding.

About 10% extra calves were purchased as spare animals and reared to provide replacements in the event of losses; data from these have been included where applicable.

Table A5.1

Experimental centres	No. per breed type	Total	Housing and feeding
Boxworth	5	25	Group housed—electronic doors to feed troughs—ad lib fed
Drayton	8	40	Individually penned—ad lib fed
High Mowthorpe	7	35	Individually penned—ad lib fed
Liscombe	5	25	Group housed—electronic doors to feed troughs—ad lib fed
Norfolk	5	25	Group housed—individual feeding yokes—fed to appetite thrice daily
		150	

Feed and management

Throughout the whole period from arrival on the farm to slaughter the animals were individually fed and records were kept of liveweight gain and food consumption for each 28-day period.

To minimize differences between centres, all calves were reared on the same milk substitute and early weaning concentrate; otherwise the normal calf rearing system of each centre was practised. The animals were castrated in the normal way by 3 months of age. After the liquid feeding phase all calves were fed the same proprietary rearing nuts until they had been on the farm for 12 weeks (84 days).

Thereafter the calves were changed to a complete pelleted diet, this was the sole food to slaughter but the cattle were bedded on straw and also offered approximately 0.5 kg hay or straw per head per day to help to counteract bloat risks.

To obtain food conversion efficiency figures and to give individual animals equal opportunity, it was necessary to offer individuals a standard complete diet which could be obtained in sufficient quantity to satisfy the needs of 150 animals fed indoors entirely throughout life; the diet described below was considered to best meet these objectives. A comparison on an all-concentrate diet was avoided as this was planned as a separate trial—see Appendix 2.

The complete diet consisted of 65% dried lucerne, 33% rolled barley, 2% high phosphorus minerals plus 800,000 international units of Vitamin D per tonne and was packaged in pellets of ½ inch (12½ mm) diameter.

To minimize variation in the diet some 450 tonnes were compounded at one plant, from lucerne cut between 20 and 28 of September 1972. Samples of the diet were analysed by ADAS Nutrition Chemists at monthly intervals to correspond with the growth rate and food record periods. The average analysis of the diet was approximately 86% Dry Matter; as fed the Crude Protein was 16.5%, the estimated Starch Equivalent 55% and the 'in vivo' D value, determined in sheep fed at the maintenance level, was 63.

Due to practical problems with equipment, food consumption data were not obtained for the whole period on all the animals; the actual results given at the end of this appendix, relate to the 115 animals for which full records were obtained. Food consumption has been excluded when only 'part periods' were recorded.

Two animals died of bloat during the early weaning stage and five from bloat on the complete pelleted diet; seven animals were withdrawn because of persistent bloating. The deaths from bloat on the complete diet occurred soon after the changeover from the calf ration. In addition ten animals died from other causes mainly pneumonia. Where possible spare animals were substituted for these losses and withdrawals. There was no clear indication of breed differences in the losses from any cause.

Slaughter and carcase assessment

It was expected that some breeds would mature earlier than others; to compare the 5 breed types on the same common basis randomly chosen animals of each breed were slaughtered serially so that within each there would be a range of ages, weights and fatness.

It was decided that equal numbers of each breed type should be slaughtered after each of 4 defined periods on the farm. The ages for each breed were decided upon, after the same observer had handled all the animals in the trial, as those likely to span roughly the same levels of fatness for each.

Animals within each breed type were allocated randomly in equal numbers to each of the slaughter groups. Where at a centre, because of unequal numbers this was not possible, extra animals were allocated to slaughter groups II or III as being those most likely to be within the commercial acceptable range.

In the event the Limousin crosses were slaughtered at earlier stages of maturity than were the other breeds because they, apparently, gave a more finished impression on handling. The target ages are in table A5.2.

Table A5.2 *Slaughter ages (days)*

		Group I	Group II	Group III	Group IV
Hereford crosses	(H×)	375	396	417	438
Limousin crosses	(L×)	375	403	431	459
Friesian	(F)	403	431	459	487
German Simmental crosses	(GS×)				
Swiss Simmental crosses	(SS×)				

The left side of each carcase was fully dissected by the Meat and Livestock Commission but the practical organisation of slaughterings at five scattered slaughter points and the collection of the sides for dissection at a central unit necessitated small departures from the planned ages of slaughter. Moreover, because of pressure of other work at the dissection unit 8 sides were not dissected. The average ages and the numbers dissected in each breed/slaughter group are given in the tables appended to this report; in total the left sides of 132 animals were dissected.

The results

The averages for the main recorded characteristics are given at the end of this appendix. There are two tables for each breed type; Table A gives the data for animals for which food consumption records were obtained and Table B summarizes the main components of carcase quality for the somewhat larger number of animals dissected. In each case the second table includes the carcase data from the animals in the first table.

Simple averages are not strictly comparable because the killing ages were not the same for all breeds and the numbers in each breed/slaughter group were small and unequal. However they show how each breed changed as it became older and heavier. Dressing out percentages increased as did the quantities of food consumed per kg of liveweight gain, per kg of carcase weight and per kg of lean meat produced. Each breed changed in carcase composition as it became heavier, increasing in fat content and decreasing in the percentage of lean and bone.

On the other hand, growth rates to slaughter, percentage of high priced cuts, lean in high priced cuts as a percentage of total lean and the ratio of lean to bone changed very little within breeds over the ages and weight ranges involved. It is permissible, therefore, to compare the overall breed averages for these characters as in Table A5.3 below.

Table A5.3 *Overall breed averages*

	F	H×	L×	GS×	SS×	se per animal
Growth rate (kg/day)	0.93	0.90	0.89	0.96	0.94	±0.16
% High priced cuts	45.7	45.9	46.8**	45.7	45.9	±0.23
Lean in high priced cuts as % of total lean	49.2	49.2	50.5**	49.3	49.6	±0.23
Lean/bone ratio	3.7	3.8	4.3**	3.9	3.9	±0.05

The significance levels indicated relate to comparisons with F

There was no significant difference in growth rate between the Hereford crosses, Limousin crosses and the Friesians, nor between the Friesians and either type of Simmental cross. The German Simmental crosses grew significantly faster ($p < 0.05$) than either the Hereford crosses or the Limousin cross cattle. Although the Swiss Simmental crosses grew faster than the Limousin and Hereford crosses, the differences were not significant.

For the carcase characters the Limousin crosses were significantly superior ($p < 0.01$) to the Friesians and also consistently better than the other three types. The lean/bone ratio of the Limousin cross cattle was particularly high whilst those of the other breed types were similar.

As mentioned above some characters changed rapidly as the animals became older and heavier and the comparison of breed averages is then inappropriate. For example the average fat percentages at slaughter varied from 17.9% for the Limousin crosses, 20.2% for the German Simmental, cross cattle, 20.7% for the Swiss Simmental crosses, 21.1% for the Friesians to 23.2% for the Hereford cross animals. Therefore, for the characters that were changing rapidly, regression analysis was used to estimate values at a constant liveweight at slaughter 430 kg; the results are given in Table A5.4. (The inclusion of further data and recalculations have changed the figures somewhat from those published in the original report of this work).

Experience has shown that if different breeds are slaughtered according to subjective estimates of degrees of finish, one breed may be more mature at slaughter than another. Direct comparisons are then of little value. Serial slaughter was adopted to avoid this situation and allow calculation of the relationships between slaughter weight and carcase composition so that comparative estimates could be produced either at the same slaughter weight or at the same degree of finish. Unfortunately the correlation coefficients (r) between slaughter weight and per cent fat were low (r varied from 0.3 to 0.5 depending on breed type) and predictions based on them are subject to error. In other words animals slaughtered at the same weight varied considerably in carcase fatness, whilst at a given degree of fatness animals varied considerably in slaughter weight. All the estimates in Tables A5.4, 5.5, 5.6 and 5.7 are therefore subject to some variation.

Table A5.4 *Estimated breed values at a standard liveweight at slaughter (430 kg) obtained from regression analysis*

	F	H×	L×	GS×	SS×
Age at slaughter (days)	424	437	443	400	414
Killing out % excluding KKCF ø	52.5	52.9	54.9*	51.6	52.3
Cold carcase weight excluding KKCF (kg)	226	227	236*	222	225
KKCF as % of cold carcase weight including KKCF	4.1	3.3*	3.3*	3.6	3.5
Weight of					
Lean (kg)	136.3	131.0*	149.4**	138.5	135.9
Bone	37.0	34.0**	34.2**	35.7	35.8
Total fat	44.8	54.9**	44.6	42.1	44.1
Subcutaneous (external) fat	15.5	23.0*	16.3	14.3	15.5
Intermuscular fat	26.9	29.0	26.0	25.4	26.2
KKCF	9.7	7.8*	8.0*	8.4	8.2
As % of cold carcase weight excluding KKCF					
Lean	60.4	57.6*	63.3*	62.4	60.5
Bone	16.4	15.0**	14.5**	16.1	15.9
Total fat	19.9	24.1**	18.9	19.0	19.6
Subcutaneous (external) fat	6.9	10.1*	6.9	6.4	6.9
Intermuscular fat	11.9	12.8	11.0	11.5	11.7
Eye muscle area (sq cm)					
10th rib	57	55	68**	62*	61
13th rib	58	60	72**	62*	61
Food consumption (kg)					
Total	2,831	2,631	2,643	2,566	2,688
Per kg liveweight	6.6	6.1	6.1	6.0	6.3
Per kg cold carcase weight excluding KKCF	12.5	11.6	11.2	11.6	11.9
Per kg lean	20.8	20.1	17.7	18.5	19.8

ø KKCF = Kidney knob and channel fat

The levels of significance indicated relate to comparisons with F.

The lean, bone and fat percentages do not add up exactly to 100 because of dissection losses which did not vary over the age and weight ranges involved.

The results in table A5.4 indicate that Limousin crosses would take the longest time to reach the standard slaughter weight and the Simmental crosses the shortest with the Friesian and the Hereford crosses intermediate between them.

The cattle would be at different stages of maturity at this slaughter weight. Limousin cross cattle would be expected to yield the highest carcase percentage, the heaviest carcase, the highest lean percentage and the lowest percentage of bone and total fat. These factors, in combination, mean they would be expected to have the greatest weight of lean at this slaughter weight.

Hereford crosses would be expected to show the next highest percentage of carcase though not significantly higher than the Friesians. The Hereford cross animals would have a similar bone content to the Limousin crosses but the highest percentages of both total and subcutaneous fat and the lowest percentage and weight of lean—significantly different in all four traits to the Friesians. Hereford and Limousin crosses would have similar percentages of bone.

For percentage and weight of lean the Hereford crosses would be the worst of the five types examined. However the slaughter weight used in this comparison was towards the upper limit of the slaughter weights for the Hereford cross cattle on this diet. This could give rise to somewhat greater inaccuracies of prediction for this cross than for the other four breed types.

Little difference would be expected between the carcase percentages and, therefore, between the cold carcase weights of the Friesians and the two Simmental crosses; all would be lower than for the Limousin and the Hereford crosses. Because the Friesians would have somewhat more bone and a somewhat higher total fat percentage they would be expected to have a smaller weight of lean than the Simmental crosses but still greater than would be expected from the Hereford cross cattle at this liveweight at slaughter.

The area of the ‘eye’ muscle exposed when the carcase is cut across, gives more idea of fleshing than does the composition only. Limousin crosses would be expected to have by far the greatest eye muscle area at this weight with the Friesians and Hereford crosses the least and the Simmental crosses intermediate.

The Friesian had by far the largest percentage of kidney knob and channel fat; whilst, for this trait, the other four types were similar. The low percentage for the Hereford crosses was particularly noteworthy in view of their much higher total fat content at this weight.

Estimates of average food consumption have also been included in the table although there was some variation in feed consumed between the Friesians and to a lesser extent, the Hereford crosses at the different centres. In contrast feed consumed by the Limousin cross animals was almost identical at all centres. It will be recalled that Limousin progeny of all five bulls were almost equally distributed over all centres while the Friesian and Hereford cross cattle could have differed genetically. These limitations on the comparisons of feed efficiency must be borne in mind in considering the data. From the expected values for food consumption the Friesians would consume the most food in total, per kg liveweight at slaughter, per kg cold carcase weight and per kg lean. The Hereford crosses, because of its fatness at this liveweight at slaughter, would be very similar to the Friesian cattle in food consumed per kg lean produced. The Limousin crosses would consume approximately the same as the Simmental crosses but in terms of lean meat produced they consumed the least of all. Per kg of lean the Simmental crosses would consume more than the Limousin cross animals, rather

Table A5.5 *Estimated breed values at slaughter (430 kg) expressed as % differences above (+) or below (−) the average for Friesians*

	H×	L×	GS×	SS×
Age at slaughter	+3.1	+4.5	−5.7	−2.4
Killing out % excluding KKCF ø	+0.8	+4.6*	−1.7	−0.4
Cold carcase weight excluding KKCF	+0.4	+4.4*	−1.8	−0.4
KKCF as % of cold carcase weight including KKCF	−19.5*	−19.5*	−12.2	−14.6
Weight of				
Lean	−3.9*	+9.6**	+1.6	−0.3
Bone	−8.1**	−7.6**	−3.5	−3.2
Total fat	+22.5**	−0.4	−6.0	−1.6
Subcutaneous (external) fat	+48.4*	+5.2	−7.7	0.0
Intermuscular fat	+7.8	−3.3	−5.6	−2.6
KKCF	−19.6*	−17.5*	−13.4	−15.5
As % of cold carcase weight excluding KKCF				
Lean	−4.6*	+4.8*	+3.3	+0.2
Bone	−8.5**	−11.6**	−1.8	−3.0
Total fat	+21.1**	−5.0	−4.5	− 1.5
Subcutaneous (external) fat	+46.4*	0.0	−7.2	0.0
Intermuscular fat	+7.6	−7.6	−3.4	−1.7
Eye muscle area				
10th rib	−3.5	+19.3**	+8.8*	+7.0
13th rib	+3.4	+24.1**	+6.9*	+5.2
Food consumption				
Total	−7.1	−6.6	−9.4	−5.1
Per kg liveweight	−7.6	−7.6	−9.1	−4.5
Per kg cold carcase weight excluding KKCF	−7.2	−10.4	−7.2	−4.8
Per kg lean	−3.4	−14.9	−11.1	−4.8

ø KKCF = Kidney knob and channel fat.
The levels of significance indicated relate to comparisons with F.

similar on average to the Hereford crosses but rather less than would the Friesian cattle.

For ease of comparison the major differences shown by the four types of crosses are given in Table A5.5 below, as percentages above (plus) or below (minus) the average for Friesians.

The previous tables show that considerable differences in carcase composition would be expected if the animals were compared at the same weight; these differences were associated with the differences in degree of maturity.

Although the correlations between slaughter weight and per cent fat were

Table A5.6 *Estimated breed values at 20% total fat in the carcase* (*excluding* KKCF ø)

obtained from regression analysis	F	H×	L×	GS×	SS×
Age at slaughter (days)	428	348	467	450	434
Liveweight at slaughter øø (kg)	434	350	469	478	449
Killing out % excluding KKCF	52.5	51.4	55.7	52.5	52.6
Cold carcase weight excluding KKCF (kg)	228	180	261	251	236
KKCF as % cold carcase weight including KKCF	4.2	2.7	3.5	4.0	3.8
Weight of (kg)					
Lean	137.4	109.1	163.6	153.0	141.8
Bone	37.2	28.6	37.0	39.2	36.9
Total fat	45.6	36.0	52.2	50.2	47.2
Subcutaneous (external) fat	15.8	13.5	19.0	17.7	16.6
Intermuscular fat	27.3	20.4	30.6	29.8	28.1
KKCF	9.9	5.0	9.4	10.4	9.3
As % of cold carcase weight excluding KKCF					
Lean	60.3	60.6	62.7	61.0	60.1
Bone	16.3	15.9	14.2	15.6	15.6
Subcutaneous (external) fat	6.9	7.5	7.3	7.1	7.0
Intermuscular fat	12.0	11.3	11.7	11.9	11.9
Eye muscle area (sq cm)					
10th rib	58	50	71	66	63
13th rib	59	53	76	67	63
Food consumption (kg)					
Total	2,863	1,926	2,974	3,038	2,822
Per kg liveweight	6.6	5.5	6.3	6.5	6.3
Per kg cold carcase weight excluding KKCF	12.6	10.7	11.4	12.1	12.0
Per kg lean	20.8	17.7	18.2	19.9	19.9

ø KKCF = Kidney knob and channel fat

øø The residual standard deviation per animal varied from 25 to 30 kg.

low, as indicated earlier, it was considered that the expected results if the cattle had all been slaughtered at the same degree of fatness (maturity) should also be shown. For this purpose both the carcase composition and the feed consumption were estimated from the relationships (imperfect though they were) for all cattle at an estimated 20% of total fat in the carcase excluding the kidney knob and the channel fat. These are given in Table A5.6.

The data above show that under the feeding regime practised there would have been a range of from 350 to 470 kg in the liveweight of the cattle slaughtered at the same degree of maturity. Killing out % would be similar except for the Hereford crosses which would be somewhat lower and the Limousin cross cattle which would be substantially higher.

If carcase fat was held at 20%, lean percentage would vary inversely with bone and the table shows that the Limousin crosses with the lowest percentage of bone would have the highest lean content. Subcutaneous fats would differ little but the highest values would be expressed in the Hereford cross animals followed by the Limousin crosses.

As a result of these differences in carcase content the Limousin crosses would yield more lean meat than either of the Simmental crosses and the evidence from eye muscle area suggests that they would show the thickest muscling and the Hereford crosses the least.

Mention was made earlier that the Friesians and Hereford crosses probably differed genetically between farms and that their food consumption was more variable than that for the imported breed crosses. These limitations should be borne in mind when considering the predicted figures. These show, however, that different total quantities of feed would be required by the crosses, depending on their estimated age at slaughter, that the differences between breeds in feed per unit weight of carcase or lean would be small but with the more favourable values from Hereford and Limousin crosses and the poorer values from the Friesian cattle.

For easy comparison of the magnitude of the expected differences the estimated breed values at 20% total fat in the carcase, excluding kidney knob and channel fat, are given as percentages above (plus) or below (minus) the average for Friesians in Table A5.7.

Sample joints obtained from the imported breed crosses from two of the centres were studied at the Meat Research Institute. In general no differences were found between the crosses, or between them and the normal levels expected in steers of this age for flavour, texture and juiciness of lean, or overall acceptability.

It is necessary to draw attention to the fact that although a vast amount of detailed data on individual performances has been recorded, relatively

Table A5.7 *Estimated breed values at 20% fat expressed as % differences above (+) or below (−) the average for Friesians*

	H×	L×	GS×	SS×
Age at slaughter	−18.7	+9.1	+5.1	+1.4
Liveweight at slaughter	−19.4	+8.1	+10.1	+3.5
Killing out % excluding KKCF ø	−2.1	+6.1	0.0	+0.2
Cold carcase weight excluding KKCF	−21.1	+14.5	+10.1	+3.5
KKCF as % of cold carcase weight including KKCF	−35.7	−16.7	+4.8	−9.5
Weight of				
Lean	−20.6	+19.1	+11.4	+3.2
Bone	−23.1	−0.5	+5.4	−0.8
Total fat	−21.1	+14.5	+10.1	+3.5
Subcutaneous (external) fat	−14.6	+20.3	+12.0	+5.1
Intermuscular fat	−25.3	+12.1	+5.1	−6.1
KKCF	−49.5	−5.1	+5.1	−6.1
As % of cold carcase weight excluding KKCF				
Lean	+0.5	+4.0	+1.2	−0.3
Bone	−2.5	−12.9	−4.3	−4.3
Subcutaneous (external) fat	+8.7	−5.8	+2.9	+1.4
Intermuscular fat	−5.8	−2.5	−0.8	−0.8
Eye muscle area				
10th rib	−13.8	+22.4	+13.8	+8.6
13th rib	−10.2	+28.8	+13.6	+6.8
Food consumption				
Total	−32.7	+3.9	+6.1	−1.4
Per kg liveweight	−16.7	−4.5	−1.5	−4.5
Per kg cold carcase weight excluding KKCF	−15.1	−9.5	−4.0	−4.8
Per kg lean	−14.9	−12.5	−4.3	−4.3

ø KKCF = Kidney knob and channel fat

small numbers of bulls and progeny were involved in this experiment; the numbers of each breed type varied from 19–25 for food consumption records and from 24–31 for carcase data.

Table of breed averages

The following tables indicate the numbers of animals involved in each breed slaughter group and the simple averages for the main recorded characteristics. Overall averages are also given.

Two tables are given for each breed type:

Table A relates to the animals for which complete food consumption records were obtained (a total of 115 animals of all breed types). Food consumption includes early weaning pellets, rearing nuts and lucerne/barley pellets, but excludes hay and straw.

Table B relates to all the animals from which the left sides were dissected. In each case this table includes the carcase data from the animals in (A) (a total of 132 animals).

Cautionary note

As stressed in the report comparisons between the simple averages are difficult and can be misleading because of:

(1) the difference between breeds in the ages at the 4 slaughter points and
(2) the small and unequal numbers in the breed/slaughter sub groups.

The statistical interrelationships of these data are illustrated and discussed in the foregoing pages.

Note In the tables which follow KKCF = Kidney knob and channel fat.

Friesian

Table A *Animals with food consumption records*

Slaughter group	I	II	III	IV	Overall
Age in days	405	436	459	488	449
No. of animals	5	7	7	6	25
Liveweight at slaughter (kg)	434	438	475	472	456
Gain/day (kg)	0.98	0.92	0.95	0.88	0.93
Cold carcase weight ø (kg)	227	232	250	254	239
Dressing out % ø	52.2	53.0	52.2	54.0	52.9
Weight of lean (kg)	139	140	150 (6)	151	145
Food consumed					
Total (kg)	2,692	2,861	3,274	3,338	3,057
Per kg liveweight gain	6.98	7.34	7.67	7.87	7.49
Per kg carcase ø	11.83	12.33	13.00	13.02	12.58
Per kg lean	19.25	20.39	22.35(6)	22.14	21.13

ø *Excluding* estimated weight of kidney knob and channel fat
The figure in brackets refers to the number in the average

Table B *Animals which were dissected*

Slaughter group	I	II	III	IV	Overall
Age in days	405	435	459	488	450
No. of animals	5	7	7	7	26
Liveweight at slaughter (kg)	434	438	475	464	454
Cold carcase weight ø (kg)	222	226	246	243	235
KKCF as % of cold carcase weight including KKCF	3.4	4.4	4.7(6)	4.3(6)	4.3
As % of carcase weight ø					
Lean	62.9	62.1	59.4	60.3	61.0
Fat	19.2	19.5	23.1	22.0	21.1
Bone	16.5	16.8	16.1	16.3	16.4
High priced cuts	46.5	45.5	45.3	45.7	45.7
Lean in high priced cuts as % of total lean	49.7	49.1	49.0	49.2	49.2
Lean/bone ratio	3.8	3.7	3.7	3.7	3.7
Eye muscle area (sq. cm)	66	58	56	56	59

ø *Excluding* weight of kidney knob and channel fat
The figure in brackets refers to the number in the average.

Hereford × Friesian

Table A *Animals with food consumption records*

Slaughter group	I	II	III	IV	Overall
Age in days	374	395	419	438	405
No. of animals	7	6	6	6	25
Liveweight at slaughter (kg)	365	404	428	429	405
Gain/day (kg)	0.87	0.93	0.93	0.89	0.90
Cold carcase weight ø (kg)	189	212	227	230	214
Dressing out % ø	51.5	52.6	53.1	53.7	52.7
Weight of lean (kg)	116	124	130	131	125
Food consumed					
Total (kg)	1,905	2,461	2,610	2,745	2,410
Per kg liveweight gain	6.02	6.88	6.88	7.22	6.72
Per kg carcase ø	10.12	11.59	11.53	11.90	11.24
Per kg lean	16.58	19.86	20.12	20.97	19.27

ø *Excluding* estimated weight kidney knob and channel fat

Table B *All animals which were dissected*

Slaughter group	I	II	III	IV	Overall
Age in days	375	397	424	440	409
No. of animals	8	7	9	7	31
Liveweight at slaughter (kg)	370	398	430	420	405
Cold carcase weight ø (kg)	188	205	222	219	209
KKCF as % of cold carcase weight including KKCF	2.7	2.9	3.8	3.3	3.2
As % of carcase weight ø					
Lean	61.7	59.4	58.9	58.6	59.6
Fat	20.7	23.8	24.2	24.2	23.2
Bone	16.0	15.3	15.4	15.5	15.5
High priced cuts	46.0	45.8	45.8	46.0	45.9
Lean in high priced cuts as % of total lean	49.5	49.2	49.3	49.0	49.2
Lean/bone ratio	3.9	3.9	3.8	3.8	3.8
Eye muscle area (sq cm)	53	55	55	54	54

ø *Excluding* weight of kidney knob and channel fat

Limousin × Friesian

Table A *Animals with food consumption records*

Slaughter group	I	II	III	IV	Overall
Age in days	378	403	432	462	417
No. of animals	5	7	8	4	24
Liveweight at slaughter (kg)	387	399	430	453	415
Gain/day (kg)	0.92	0.88	0.88	0.89	0.89
Cold carcase weight ø (kg)	205	217	237	251	225
Dressing out % ø	52.9	54.3	55.1	54.8	54.4
Weight of lean (kg)	132	137	149(6)	158	144
Food consumed					
Total (kg)	2,115	2,395	2,661	2,965	2,520
Per kg liveweight gain	6.26	6.94	7.18	7.36	6.95
Per kg carcase ø	10.32	11.04	11.25	12.01	11.12
Per kg lean	15.95	17.54	17.52(6)	18.70	17.40

ø *Excluding* estimated weight of kidney knob and channel fat
The figure in brackets refers to the number in the average

Table B *All animals which were dissected*

Slaughter group	I	II	III	IV	Overall
Age in days	378	405	432	465	419
No. of animals	6	8	6	6	26
Liveweight at slaughter (kg)	364	408	418	446	409
Cold carcase weight ø (kg)	184	217	224	244	217
KKCF as % of cold carcase weight including KKCF	2.9	3.3	3.3	3.5(5)	3.2
As % of carcase weight ø					
Lean	67.3	64.5	66.7	63.8	65.5
Fat	15.0	19.4	16.2	20.5	17.9
Bone	16.0	14.7	15.7	14.3	15.1
High priced cuts	47.3	46.9	47.1	46.0	46.8
Lean in high priced cuts as % of total lean	51.1	50.3	50.7	49.9	50.5
Lean/bone ratio	4.2	4.4	4.3	4.5	4.3
Eye muscle area (sq cm)	63	65	71	71	67

ø *Excluding* kidney knob and channel fat.
The figure in brackets refers to the number in the average.

German Simmental × Friesian

Table A *Animals with food consumption records*

Slaughter group	I	II	III	IV	Overall
Age in days	401	434	460	488	445
No. of animals	5	7øø	5	5	22
Liveweight at slaughter (kg)	451	453	482	498	469
Gain/day (kg)	1.01	0.95	0.94	0.93	0.96
Cold carcase weight ø (kg)	234	238	258	271	249
Dressing out %ø	51.8	52.3	53.4	54.3	529
Weight of lean (kg)	140	151(6)	163	158	153
Food consumed					
Total (kg)	2,629	2,751	3,089	3,450	2,959
Per kg liveweight gain	6.67	6.80	7.28	7.79	7.10
Per kg carcase ø	11.27	11.56	11.99	12.87	11.89
Per kg lean	18.84	19.27(6)	19.01	21.88	19.70

ø *Excluding* estimated weight of kidney knob and channel fat
The figure in brackets refers to the number in the average.

Table B *All animals which were dissected*

Slaughter group	I	II	III	IV	Overall
Age in days	401	437	461	488	450
No. of animals	5	7øø	6	7	25
Liveweight at slaughter (kg)	451	459	491	504	478
Cold carcase weight ø (kg)	225	239	254	263	247
KKCF as % of cold carcase weight including KKCF	3.5	3.8	3.6	4.6(6)	3.9
As % of carcase weight ø					
Lean	62.0	62.7	64.5	60.6	62.4
Fat	19.7	20.1	18.5	22.2	20.2
Bone	16.8	15.8	15.5	15.7	15.9
High priced cuts	46.0	45.9	46.1	45.0	45.7
Lean in high priced cuts as % of total lean	49.6	49.6	49.5	48.7	49.3
Lean/bone ratio	3.7	4.0	4.2	3.9	3.9
Eye muscle area (sq cm)	55	70	68	65	65

ø *Excluding* weight of kidney knob and channel fat

øø There were 8 animals allocated to this slaughter group, but no food records were obtained for one animal and no carcase data for a different one; thus the figures in Tables A and B relate to different sets of seven animals.

Swiss Simmental × Friesian

Table A *Animals with food consumption records*

Slaughter group	I	II	III	IV	Overall
Age in days	403	432	458	485	447
No. of animals	3	6	6	4	19
Liveweight at slaughter (kg)	415	466	464	513	467
Gain/day (kg)	0.91	0.98	0.92	0.96	0.94
Cold carcase weight ø (kg)	221	247	244	272	247
Dressing out % ø	53.1	52.9	52.7	53.0	52.9
Weight of lean (kg)	140	147	145	161	148
Food consumed					
Total (kg)	2,517	2,896	2,955	3,326	2,945
Per kg liveweight gain	7.03	7.06	7.13	7.27	7.12
Per kg carcase ø	11.44	11.78	12.09	12.26	11.92
Per kg lean	18.03	19.83	20.42	20.75	19.92

ø *Excluding* estimated weight of kidney knob and channel fat

Table B *All animals which were dissected*

Slaughter group	I	II	III	IV	Overall
Age in days	408	433	459	488	448
No. of animals	4	8	7	5	24
Liveweight at slaughter (kg)	409	470	459	495	462
Cold carcase weight ø (kg)	210	238	236	254	236
KKCF as % of cold carcase weight incl KKCF	3.0	3.9	4.2	3.7	3.8
As % of carcase weight ø					
Lean	64.9	62.2	60.6	60.0	61.7
Fat	16.1	20.7	22.3	22.4	20.7
Bone	17.1	15.7	15.7	16.2	16.0
High priced cuts	45.8	45.8	46.3	45.9	46.0
Lean in high priced cuts as % of total lean	49.1	49.4	50.2	49.7	49.6
Lean/bone ratio	3.8	4.0	3.9	3.7	3.9
Eye muscle area (sq cm)	62	65	63	65	64

ø *Excluding* weight of kidney knob and channel fat

Appendix 6

Economic evaluations

Breeding

The evidence available to us indicates that the imported bulls give satisfactory conception rates.

Extended gestation lengths might reduce the annual production of calves from a herd. A delay of 2 months in calving index was estimated to cost £15 per cow (MMB 1964). Allowing for the increase in milk price we suggest that prolongation of gestation might now cost at least 60p per day in dairy herds.

If calves are valued at £25–£50 each, an increase of 1% in calf mortality represents a charge of 25p–50p per surviving calf.

Difficult calvings may result in the death of the cow and often incur additional costs.

We have no record of cow deaths but, as an example, if cow deaths occurred on one in ten of the occasions when there was dystokia an increase of 1% dystokia would represent a loss of £27 or approximately 27p per surviving calf. (Value of cow £300 less casualty value £30.)

Seriously difficult calvings also have direct economic effects. These might approximate to:

Veterinary bills and overtime	£20
Loss of milk say, 2 litres/day for 100 days (this applies only to dairy cows)	£18
Delay in conception say, 20 days	£12
	£50

the average cost of 1% seriously difficult calving is therefore about 50p per surviving calf. If 'some assistance' at calving resulted in one tenth of these costs it would amount to 5p per 1% of assistance recorded, per surviving calf.

In addition there is the intangible but nevertheless real consideration of disturbance and distress to the cow, the stockman and the farmer. This cannot be accounted for in financial terms but we believe it may have a decisive influence in many herds, on the choice of breed or of bull.

Finally, a market factor should be considered. At present Hereford cross Friesian calves attract a premium of £10–£20 and breeds which less consistently colour mark their calves are at a disadvantage unless special steps are taken to identify the calves.

In making the assessment in Table A6.1 we have estimated the number of surviving calves from each of the breeds, on the basis of the data in Appendix 1, have credited the expected calf weight at birth at 55p per kg liveweight and have then made deductions for gestation, calf mortality and calving difficulty as set out above.

The figures in Table A6.1 show that the return from the imported breeds would be about £1.50 more than from the Herefords, the advantages in increased calf weight from the imported breeds having offset the additional difficulties associated with calving.

Table A6.1 *A comparison of the financial output per year from a herd of 100 Friesian cows mated to Hereford and imported breeds*

		H	L	GS	SS
Expected number of calvings and calves		95	95	95	95
Adjusted for gestation length $(95 \times \frac{H}{Y})$ (Table A1.4)		95.0	93.2	94.0	93.8
Adjusted for calf mortality (x 100 – M) (Table A1.1)		92.4	90.1	90.2	89.7
Weight of calf (Table A1.5)	(kg)	36.0ø	41.7	43.5	44.2
Total weight of calves produced	(kg)	3,326	3,757	3,924	3,965
Value of calves produced at 55p per kg	(£)	1,830	2,066	2,158	2,181
Deductions					
Dystokia (Table A1.2)	(%)	0.9	2.4	3.3	3.7
at 50p per 1% per calf	(£)	41.6	108.1	148.8	165.9
Some assistance	(%)	10ø	18	24	31
at 5p per 1% per calf	(£)	46.2	81.1	108.2	139.0
Cow mortality at 27p per 1% per calf	(£)	22.5	58.4	80.4	89.6
Total deductions	(£)	110.3	247.6	337.4	394.5
Value of calves produced less deductions	(£)	1,720	1,818	1,821	1,787
Net value per calf	(£)	18.6	20.2	20.2	19.9
Colour marking	(%)	100	—	90	90

øassumed figure

If the calves were to be marketed there would be an additional premium from the Hereford cross calves unless the breeder took special steps to authenticate the breeding of those by imported bulls, particularly the Limousin crosses.

Feeding

In comparing the results from the Experimental Centres the data for estimated 20% fat in the carcase (excluding KKCF) have been taken (Table A5.6). A feed price of £55 per tonne of dried lucerne/barley mix has been taken and a price of £28 per live cwt for calves and finished cattle (55p per kg liveweight or at 55% KO = £1 per kg carcase weight). A margin has then been calculated for carcase value less cost of calf and feed. The margin is to pay non feed variable costs, common costs including labour, housing and interest on capital and provide a profit. These are expressed as margins per head, per day and per hectare in Table A6.2.

Table A6.2 *Margins from Experimental Centre results*

		F	H×	L×	GS×	SS×
Total feed	(kg)	2,863	1,926	2,974	3,038	2,822
Feed cost	(£)	157	106	164	167	155
Calf weight	(kg)	44	36	42	44	44
Calf cost	(£)	24	20	23	24	24
Carcase value	(£)	228	180	261	251	236
Margin per head	(£)	47	54	74	60	57
Days to slaughter		428	348	467	450	434
Margin per day	(p)	11.0	15.5	15.8	13.3	13.1
Margin per haø	(£)	131	224	199	158	162

ø Lucerne/barley diet @ 8,000 kg/ha

The Limousin followed by the Simmental crosses yielded the highest margin per head and per day but when account was taken of area of feed the Hereford exceeded the margin for Limousin with Simmental crosses and Friesians giving lower margins.

If credit were given for lean content the margin per head for Limousin crosses would be increased by £9 whilst the other remain the same.

From the farm cereal feeding trials similar calculations can be made—Table A6.3. For this purpose it was assumed that feed cost was £75 per tonne, that calves cost 55p/kg and that a carcase was worth £1 per kg. In addition, to compare feed costs a figure of 5.5 kg feed per kg gain was assumed for Friesians and the figures for the other crosses adjusted in the same ratio as in the Experimental Centre trials (Table A5.6).

Table A6.3 *Margins for farm cereal beef*

		F	GS×	F	SS×	L×
Carcase weight ×£1 per kg = value	(£)	221.3	225.2	224.7	225.6	232.6
less						
Calf purchase	(£)	65.7	65.3	75.5	73.5	70.2
Total gain in finishing period	(kg)	277.6	285.3	260.9	263.8	272
Feed per kg gain		5.5	5.4	5.5	5.3	5.3
Total feed	(kg)	1,527	1,541	1,435	1,385	1,428
Feed cost	(£)	114.5	115.6	107.6	103.9	107.1
Margin over calf purchase + feed cost	(£)	41.1	44.3	41.6	48.2	55.3
Margin per day of finishing period	(p)	16.0	18.2	17.9	20.9	22.8

The Simmental crosses yielded increased margins of £3.2 and £6.6 per head and 2.2p and 3.0p per day compared with contemporary Friesians while the Limousin crosses yielded £13.7 per head and 4.9p per day more than Friesian cattle.

It is not practicable to compare the results on the semi-intensive farm studies with the same precision, and indeed a comparison with Hereford cross Friesians would have been the most widely applicable comparison. However, from the carcase weight and age at slaughter, with carcase valued at £1 per kg the figures in Table A6.4 show that, in Scotland, German Simmental crosses on average yielded 47.3p per day of age compared with contemporary Friesians at 44.6p but, in England, German Simmental, Swiss Simmental and Limousin crosses did not differ from contemporary Friesians.

Table A6.4 *Carcase value based on semi-intensive trials*

	Scotland				England				
	Farms		Colleges						
	F	GS×	F×A	GS×A	F	GS×	SS×	L×	F
Carcase value (£)	279	313	294	310	242	246	239	232	241
Carcase value per day of age (p)	46	52	46	48	42	42	41	40	41

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